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DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

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CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES.

(Plate XI.)

By Franz von Tavel.

[*Continued from page* 58.]

III. Fenestella Platani, *n. s.*

Several dry branches of *Platanus* attacked by *Discula platani* and two forms of *Cytispora* were placed in moist air and left to themselves. It was the end of October before the observations could be taken up again. The *Cytispora* forms were still present, and between them protruded a number of long black necks of the perithecia of a Pyrenomycete not described in any of the systematic works which we used. It was, therefore, very minutely examined; its development could not, of course, be followed out completely, but it yielded some noteworthy results.

The starting point of the investigation was, as has been said, a form of *Cytispora*. The great variability of this form makes it doubtful whether or not it is identical with *C. platani*, described by Fuckel, E. F. N., No. 334. While still in the younger stages *Cytispora* shows itself on a branch in the form of small swellings 1–3 millimeters in diameter. The bark soon ruptures and the well known worm-shaped masses, which here have a waxy-yellow and often a whitish color, project through the openings. Upon removing them a black body, the stroma, may be seen through the crack in the bark. The stroma continues to increase in size, making the opening in the bark wider and then projecting through it. In the meantime new spore-masses protrude. The branches were kept in tall cylindrical jars containing some water at the base. It was apparent that the largest stromata existed at the base of the branches while the fungus developed very sparingly at the tips. It seems, therefore, that a high degree of moisture promotes the growth of the fungus. Fully-developed specimens of *Cytispora* often attain a diameter of one-half a centimeter; ten spore-masses may project from the stroma at the same

time. In old individuals the stroma frequently spreads over the surface of the branch, if only to a limited degree.

The structure of a fully-developed *Cytispora* is made clear by longitudinal and tranverse sections. The bark has been destroyed and broken through by a cone-shaped stroma which also sends hyphæ into the surrounding cells of bark parenchyma and breaks them down. This stroma is composed of a dense mass of irregularly-interwoven, coarse, brownish hyphæ. Within this are a greater or less number of cavities which are not surrounded in the young stages by specially-differentiated cell-layers, but in the older stages are inclosed by a brown or black wall; they are round at first, but finally irregular in form, possessing numerous folds and invariably lined with a hymenium. The development of the stroma begins from below and grows strongly toward the surface and a little toward the sides. The hyphæ at the apex which come in contact with the air swell up. * * * Even before the stroma has broken through the bark we can see in it dense knots of hyphæ distinguished by their transparency, which steadily increases after they attain their full size, which is very indefinite. The growth ceases in the interior while it continues at the periphery. Consequently cavities arise into which spore-forming hyphæ immediately grow from all sides. The pycnidia retain the power of growth for some time, and, therefore, frequently become adjacent or grow against obstacles so that their circumference is often very irregularly wrinkled. By the growth of the stroma they come to the surface, where their wall disintegrates and the spores escape. The pore, a special arrangement for the perforation of the wall, which is often present, is lacking in this case. The wall of the pycnidium arises from the knot of hyphæ and often can scarcely be distinguished from the stroma. In younger specimens it can usually be seen simply as a brown layer surrounding the cavity. In old specimens, however, and on pycnidia that have reached the surface, it often attains a considerable thickness and is dark brown or black. This is particularly the case with pycnidia, which together with the stroma extend over the surface of the branch. These protrude for a long distance out of the stroma; but the beginnings of the pycnidia occur only in the basal portion of the stroma.

The basidia are simple and filiform and cut off spores in immense numbers. The spores are one-celled, colorless, straight, and cylindrical. Their size is very variable; generally they are 3–4μ long and 1–2μ in diameter, but they have been observed 12μ long and 5μ in diameter.

It may be added here that the *Cytispora* under consideration is exceedingly variable. The size and shape of the stroma and pycnidia and the number of the latter are very inconstant. In view of this case too much care can not be taken in systematic investigations of this kind of fungi. The greatest weight should be laid on the form of the basidia and spores, since these show relatively the greatest constancy.

When the stroma of *Cytispora* has reached a certain size the forma-

tion of pycnidia gradually ceases, and is replaced by the development of perithecia; this occurs independently of the time of year, only requiring a sufficient amount of moisture. Moreover, only the feebly-developed stages of the *Cytispora* are found in the open air, and no perithecia at all.

The perithecia first appear at the base and are most numerous in the center of the stroma, while the pycnidia occupy the circumference. The first beginnings of the perithecia consist of small, globose knots of hyphæ, plainly visible on account of their greater transparency, which distinguishes them from the darker stroma. They are clothed on the outside by a layer of fine, delicate, brownish hyphæ, which are more or less parallel and run in the direction of the axis. The knots themselves consist of pseudo-parenchyma, whose cells are small and thin-walled but stronger than those of the outer layer. In what follows, the latter will be designated as the *outer* and the former as the *inner* perithecium wall. Within this pseudo-parenchyma an organ has been twice observed which might be called "Woronin's hypha" or perhaps an "ascogonium." In the first or younger stage it was, as compared with the surrounding tissue, a spirally coiled hypha with two turns and filled with dense protoplasm, which distinguished it clearly from its surroundings. The second case observed was of an older stage. The mass of tissue forming the young pycnidium was larger, but its structure was essentially the same. In this case the place of the pseudo-parenchyma was nearly filled up by a large coarse hypha which was wound up into a knot. It was no longer a simple spiral, but had a more complicated form. As far as could be made out it consisted of two or three coils, lying one within another, with simple ones at both the top and bottom. Here, too, the cell contents were denser than in the surrounding tissues. In this case some few cells were especially prominent on account of their size, but it could not be decided whether or not they were connected with the large hyphæ or were the beginnings of future asci.

In spite of a continued search we failed to observe any other stages. It is difficult to hit upon just the right stages of development, for thin sections of these stromata are not easily made, and the hyphæ in question may not always be so well developed. It therefore remains to be seen whether this hypha is directly connected with the formation of the asci; that is, whether it is an ascogonium or Woronin's hypha.

In older stages the circumference of the perithecium is considerably larger. A very rapid growth takes place at the apex, forming a perithecium neck which penetrates the stroma. The neck is for a long time of nearly the same diameter as the perithecium, and it is not until it projects above the stroma that the lower portion increases in circumference. The differentiation of tissues observed in the earliest stages can also be seen later on. The outer wall, whose hyphæ in the meantime have become coarser and browner, surrounds the entire reproductive body, and the neck is formed from it. It is composed of hyphæ which

are parallel to its long axis and which, diverging on the surface, clothe it with a kind of felt. The hyphæ on the inside which line the neck canal also bend outward and form hairs. These are all directed obliquely upward so as to permit the escape of the spores but to guard the entrance to the perithecium. In the older as well as the earliest stages the inner wall is composed of a colorless thin-walled pseudoparenchyma, and surrounds the entire cavity of the perithecium with the exception of the neck. The origin of this cavity and of the neck canal can not be definitely decided. The paraphyses and asci arise from the inner wall; the former are present in large numbers and are very long, slender, and thin walled. Their contents consist of finely granular protoplasm containing many globules that reflect the light.

In their earlier stages the asci are composed of extremely delicate club-shaped cells filled with strongly refracting protoplasm. Their wall remains very delicate even when they are fully grown. The form of the mature ascus is that of a cylinder, obtuse at the upper end and suddenly contracted below into a short, slender pedicel. It contains eight spores, which are oval, dark-brown, and three-septate at maturity. The two middle cells are each again divided by an oblique wall, which disappears when the spore is turned through an angle of 90° (Fig. 6). Very rarely there are a greater or less number of cell walls than stated above. The spores are slightly constricted in the planes of the septa, and the whole is surrounded by a thin, gelatinous layer. The length of the spore averages 14–18μ, the diameter 5–9μ.

The details of the perithecium having been fully examined, the point has been reached when the systematic position of the fungus should be more thoroughly considered. The main points upon which this depends are the following: The brown spores with their longitudinal and transverse septa; the presence of paraphyses; the existence of a stroma, if only an imperfectly developed one, which is certainly Valsoid, as is proved by the fact that it is very small in circumference and has perithecia projecting from the center and pycnidia from the circumference (Fig. 7). Of all known genera *Fenestella* is the only one which can be considered, since it is characterized by the above-mentioned points. Besides, there is no reason why the fungus should not be placed in this genus. It should be mentioned, however, that in most species of *Fenestella*, especially the native species *F. princeps*, the spores have many more septa; yet Saccardo mentions those having but few. This species differs from all other *Fenestellæ* in the great development of the neck, which gives it the appearance of a *Valsa*, and when the color of the spores is taken into consideration it stands very close to a *Pseudovalsa*. It may therefore be decided, merely on account of the longitudinal septa (which, as stated above, are visible only in a certain position of the spore) that it should be classified not as a *Pseudovalsa* but a *Fenestella*. Although the presence or absence of two walls is a very small matter in itself, and certainly one to which no great systematic value can

be attached, it would nevertheless, under the present system of classification, be impossible to do otherwise without revising the characteristics of an entire genus and rendering its position in Saccardo's artificial system impossible. These questions are for systematists to decide; in the present investigation it is perfectly immaterial whether its object is called *Fenestella* or *Pseudovalsa*.

As to the species, the one under consideration varies in the structure of its spores from all known species; that is, from all *Fenestella* and *Pseudovalsa* species cited in Saccardo's "Sylloge Fungorum." It can therefore be given the name of *Fenestella platani*.

The ascospores retain the power of germination for a long time. Material that had been kept dry for five months yielded the same results as that which was fresh. This question now suggests itself: Into what do the ascospores develop? The resulting body differs with the substratum. Cultures in nutritive solutions gave different results than those on fresh *Platanus* leaves. We will first follow the development of the fungus in a nutritive solution.

In water, in a nutritive solution like a decoction of the plum, grape juice, or extract of meat, or in some such solution thickened with gelatine, the ascospore germinates, as a rule, within twenty-four hours. Germ tubes arise sometimes from all, sometimes from only one cell in the spore. They penetrate the strong spore membrane, and the protoplasm passes from the spore into the germ-tube, giving the former a paler appearance. Generally the germ-tube swells up immediately after its exit from the spore; this is especially the case in water cultures where the fungus does not develop any further. In this case the germ-tubes generally remain quite short, sometimes becoming almost globose and beginning to cut off spores. Under favorable conditions they grow somewhat longer and even branch, but become divided up into short roundish cells and form gonidia at the apex (Fig. 8). These are oval, unicellular, and colorless. They soon put out a germ-tube, sometimes two, which again detach gonidia in a short time. Their further development was not observed.

In sowings upon gelatine which was mixed with a nutritive solution, the germ-tubes, unlike those sown in water, show a vigorous terminal growth, while their diameter increases very little; but even in this case the base remains thick and composed of short cells. The septa are formed at some distance behind the growing point, and numerous monopodial branches are also developed. On account of the large number of germ-tubes produced by the spore at the same time, and their vigorous growth, the mycelium attains a very considerable growth in a few days, in the center of which the dark-colored spore remains visible for some time.

After from five to six days some of the hyphæ which have come to the surface of the gelatine, or those that run just underneath it, send up numerous branches composed of one or two cells and bearing a pretty

large spherical head, the study of which is not easy. When placed in water it goes to pieces at once, leaving only a mass of colorless, cylindrical cells 3–5μ. long and 1–2μ. in diameter. The structure can be seen only when it can be observed in moist air under a cover glass. At the end of each branch of the mycelium is a globose, gelatinous mass, which swells strongly upon the addition of water and finally breaks in pieces. In it are imbedded a considerable number of the cells already mentioned, lying close together and parallel (Fig. 9). They have been cut off from the sporophore, and the gelatinous mass is composed of the envelopes of the individual gonidia.

The ascospore has therefore produced a gonidia-forming mycelium, a *Hyphomycetes*, belonging to the form *Acrostalagmus*, as is shown by the peculiar structure of the fruiting head. This form seems to be different from that of *A. cinnabarinus*, Corda. When very finely developed it has the appearance of a reddish mat, but the sporophores are never branched as in *A. cinnabarinus*. The spores of the latter are smaller than those of the form under consideration, but the development of the spores and the relations of the gelatinous envelope differ in no way from those of *A. cinnabarinus*. When *Acrostalagmus* was cultivated independently, its development was much more luxuriant; but pycnidia never made their appearance in these cultures; it seemed as if gonidia always reproduced the same gonidial form. It should also be mentioned that when the leaves were infected with ascospores *Acrostalagmus* nearly always appeared.

The development of sporophores and formation of spores continues on the *Fenestella* mycelium for a long time. The great masses of spores which fall off during the study of the fungus often makes this very difficult, and it is principally owing to them that the ascospores themselves are no longer visible.

Afterwards new changes occur in the *Fenestella* mycelium. A dense mat is generally formed by the repeated branching of the hyphæ and the formation of new ones from spores. This mat is called a stroma, although it deviates considerably from that formed in nature. At first the stroma of the slide cultures is not black or brown, but yellowish, which is probably caused by the rapid development incident to abundant moisture, for as a rule old cultures and those kept dryer take on a darker color. It can also be ascribed to the same cause, that the separate hyphæ are more delicate than those observed in nature. The outer form of an artificially produced stroma is therefore different from the natural one, and it can attain considerable dimensions if the substratum is a favorable one. Besides it does not have the conical shape described above, but forms a thin layer about 1 millimeter thick, upon, instead of within, which are the later formed pycnidia. We will return to this point farther on.

About three or four weeks after the sowing of the ascospores, numerous brown bodies, about 1 millimeter in diameter, which proved to be

pycnidia, made their appearance upon the stroma. They are usually arranged more or less in circles. In old stromata one often sees several concentric circles of pycnidia, since new rows are constantly being formed toward the circumference.

The pycnidia appear first as small knots of hyphæ; in certain places in the stroma the hyphæ wind much closer together; these points therefore appear darker, and are easily seen. These knots steadily increase in circumference for some time without any kind of differentiation. They represent merely small outgrowths of the stroma, nor do sections through this immature stage show anything but a homogeneous mass of hyphæ. Next, the young pycnidia begin to turn brown, that is, the outer layer of the tissue becomes dark colored and can be clearly distinguished as the rind. The remaining portion of the pycnidium remains unchanged until finally the hyphæ in the center move apart from each other, forming a small cavity (Fig. 10). This arises from the cessation of growth within the tissue, while the body continues to grow at the periphery. In this way the pycnidium develops into a spherical body containing a large cavity. Below, it is a little immersed in the stroma, but is distinctly separated from it by the outer layer. The wall is composed of two layers, the rind and a clearer layer within, also composed of irregularly interwoven hyphæ, without a trace of pseudo-parenchymatic structure. Immediately after the cavity begins to form, hyphal branches grow out into it and form a continuous hymenium. They cut off very small, cylindrical spores in great numbers. When the pycnidium is mature it ruptures in an irregular manner at the point, and the spores emerge in waxy, yellow, or whitish, worm-shaped masses.

In the preceding description a single pycnidium developing without any hindrance has been considered, but it is often the case that the first stages of any pycnidia arise close together. On account of the enlargement of the knots of hyphæ they collide, assume irregular forms, and grow together into various shaped bodies, yet in such a manner that the bounding lines of the individual pycnidia can be seen by the depressions between them. A rind following the depressions is formed on the outside; but within, the lateral walls are broken through by the formation of the cavities so that the compound body made up of many pycnidia possesses but one cavity. The depressions mentioned above correspond to projections upon the inside. The walls, consequently, appear wrinkled.

Now, are these pycnidia homologous with those with which the investigation started, the *Cytispora?* In the first place it may be stated that the form of the basidia and spores is the same in both, although they are as a rule a little smaller in the cultivated pycnidia. The structure of the walls agrees in the two, at least when the *Cytispora* pycnidia are young. The same things many be said of the older, black, and thick-walled pycnidia that have been said above concerning the stroma. The difference is more marked, because in the artificially produced specimens the pycnidia are superficial, while in the natural ones they are sunken

into the stroma. It has, however, been shown that in *Cytispora* individual pycnidia may project beyond the stroma. As regards the artificial ones we have only a variation dependent upon external conditions.

To this correspond the relations of the spontaneous *Cytispora* upon other substrata than twigs. Spores of the same kind were sown upon a well sterilized wilted leaf. The result was a stroma with pycnidia, having exactly the same appearance of that produced upon the slide. Infections of living and dead branches with *Cytispora* spores were without result.

It may also be mentioned that the circular arrangement of the pycnidia upon the slide points to a Valsoid stroma.

The beginnings of the pycnidia and their transformation into irregular chambers can not be so easily studied in the natural as in the cultivated *Cytispora*. But the results are in no way contradictory. In the natural *Cytispora*, also, the beginnings appear as knots of hyphæ of a globose form, which are by the least growth of the stroma brought very close together, and consequently must change their form and even coalesce on further growth.

What has been said suffices to show that there is no difference between the *Cytispora* and the pycnidia produced upon the slide, and that such variations as are present are traceable to the conditions necessary in culture methods; the two are therefore homologous.

Now since the beginnings of *Fenestella* perithecia have been formed directly upon the stroma of *Cytispora*, and the development of *Cytispora*, from the ascospore has been observed step by step upon the slide, the life history of the fungus is closed for us. That perithecia should be produced under the conditions necessary to the culture method was not to be expected. They would likewise have arisen in the form of knots of hyphae within the circle of pycnidia.

Although the pycnidia are extraordinarily small and spermatia-like, they possess the power of germination. In a suitable nutritive solution the spores swell up greatly and develop two or three germ tubes, which are much enlarged at their bases, so that afterwards it is often hard to say which is the swelling and which the spore. They proceed to branch like a budding fungus, afterwards one branch shows a strong growth at one end. Otherwise the mycelium develops in the same manner as from the ascospore.

The life history of the *Fenestella* is, however, by no means completed with what has been recorded. In order to prove whether the fungus was related to the *Cytispora*, sowings of the ascospores were made upon *Platanus* leaves and produced what is presumably a new stage of this pleomorphic form.

The spores were sown in a drop of water and this placed upon the lower surface of fresh young leaves and these kept moist. Germination was observed in a few days, but the penetration of the germ tubes was not seen. The inoculated parts began to turn brown without the fungus

becoming visible. Not until ten or fourteen days after inoculation, when the leaf had become brown and withered, did transparent points, which were most numerous along the nerves and less so upon the leaf surface, make their appearance. These points represent pycnidia, which are altogether different from those of *Cytispora*. They are situated under the epidermis, which they push up while their bases are more or less immersed in the leaf tissue. At the apex of the swellings the epidermis ruptures, forming an irregular roundish opening through which may be seen the ostiolum of the pycnidium, which will be described in detail below. The pycnidium is flattened and lenticular, yellowish in color, except the ostiolum, which is dark brown. Its walls, unlike those of the *Cytispora* (Fig. 11), are of a pronounced pseudoparenchymatic structure. They are clearly composed of two layers, the outer consisting of from one to three rows of flat cells with brown contents. Brown hyphæ usually originate from many of the superficial cells. This layer has a special structure at the apex of the pycnidium. It becomes much thicker and its cells take a radial direction, lying parallel to each other and forming papillæ-form projections on the surface. The papillæ are surrounded by a chaplet of long four or five-celled hyphæ, which arise from the outer cell and project beyond the epidermis. On account of the radial arrangement of the cells at this place the opening of the pycnidium will depend upon its time of maturity, since the cells are easily pushed apart. There is, therefore, here a similar arrangement to that in *Discula platani*.

Within this is a second layer of somewhat polygonal colorless cells which are flattened on the outside, but are more isodiametric within. The farther they are situated toward the interior the smaller their lumina. This layer bounds the cavity of the pycnidium, which is, however, very irregular, since the inner layer sends complex projections into it from all sides. From these, large round cells filled with dense contents arise everywhere. They are the basidia, but they do not form a continuous hymenial layer. They cut off oval (often rather cylindrical) unicellular colorless spores that measure 6–9 by 3–5μ.

These pycnidia are strongly characterized by the structure of their walls, and more especially of their apices, and the form of their basidia. Since little stress is laid upon these characteristics in systematic works, it was impossible to classify it in any existing genus. It would be superfluous to establish a new one, since in all probability it is only a stage in the life history of *Fenestella platani*.

Since the culture of these pycnidia in nutritive solutions was unsuccessful (concerning which more will be said) many questions relative to their development must remain unanswered. The youngest stage observed consisted of a knot of numerous coarse hyphæ (Fig. 12). It appears to originate from the *Cytispora*, although it is noticeably different from the beginnings of the *Cytispora* pycnidia. The number of hyphæ is smaller, but the hyphæ are proportionally stronger. Unfort-

unately it could not be determined whether the cell masses which projected into the cavity and bore a portion of the basidia are remnants of a ruptured tissue or whether they grow out from the inner layer of the wall after the formation of the cavity.

When sown upon gelatine and a nutritive solution the spores will in about twenty hours swell up and produce a germ tube. This develops into a mycelium of short-celled hyphæ whose growth soon ceases, while the cell contents become brown. In this way numerous more or less compact opaque masses of hyphæ are produced, which form a resting condition like sclerotia and may be called resting mycelia.

After remaining in a dry condition for some time these were again placed in a nutritive solution, the hyphæ masses began to grow again, but developed directly into an interwoven tissue and after a short space showed no further phenomena of growth.

But, on the contrary, if one of these resting conditions is placed on a leaf and kept moist the formation of pycnidia will follow. The pycnidia are therefore closely dependent upon the leaf, but this does not make them absolute parasites, since they only become apparent after the leaf is disorganized. Whether this disorganization was caused by the fungus or external causes is hard to say.

As already stated, the above described pycnidia which appear on the leaf are produced by sowing ascospores or by a perennial mycelium. They will develop also, however, if the spores formed in the pycnidia are sown on a leaf. Under the most favorable conditions of growth a pycnidia-forming mycelium arises from these, but under unfavorable circumstances a resting mycelium. Besides this the same pycnidia occurred after the sowing of *Cytispora* spores upon a fresh leaf, the latter being formed in a pycnidium produced under artificial cultivation. The manner of development of the pycnidia on the leaf was the same in all cases.

One important circumstance has not been mentioned. The pycnidia upon the leaves were in most cases accompanied by an *Acrostalagmus* form. But sowings of the latter on fresh leaves only produced the same form again.

We have now mentioned all the forms that could be obtained for observation which it is possible to suppose belong to the life history of *Fenestella platani*. The absolute proof of the connection between the ascospore and pycnidium is lacking in case of the pycnidia on the leaves. What has already been said makes it seem very likely that this stage is really connected with the *Fenestella*. As concerns the other forms, it is true that on the above grounds we can not trace the hyphæ from the gonidiophores of the *Acrostalagmus* back to the ascospores, still less can it be done for the later appearing pycnidia of the *Cytispora*. But the regularity with which both appear in all the cultures, and the similarity of the cultivated *Cytispora* pycnidia with the natural ones, leave no doubt as to their connection.

Aside from pycnidia on the leaves, the development of *Fenestella platani* is as follows:

The ascospores give rise to a mycelium which immediately cuts off gonidia—the *Acrostalagmus* stage. Later the mycelium develops into a stroma in which pycnidia are formed—the *Cytispora* stage. Finally perithecia break out of the stroma between the pycnidia—the *Fenestella* stage. Cultures of *Acrostalagmus* reproduced the same gonidial form, and no pycnidia; cultures of *Cytispora* both artificial and natural yielded the same pycnidia again. Under favorable circumstances, however, perithecia might be developed.

If the pycnidia that occur on the leaves really belong to *Fenestella*, then this fungus possesses both a parasitic and saprophytic cycle of development. The uncertainty which still exists in regard to this makes it undesirable to go farther in order to draw general conclusions.

(*To be continued.*)

PEACH ROT AND PEACH BLIGHT.

(*Monilia fructigena*, Persoon.)

By Erwin F. Smith, Sc. D.

For six years my attention has been drawn repeatedly to the serious losses resulting from the parasitism of *Monilia fructigena* upon plums and other stone fruits, and during the last three years my opportunities for observing its effect upon the peach have been unrivaled. These opportunities occurred principally in the great peach district lying between the Chesapeake and Delaware Bays. There, in the prosecution of the peach-yellows investigation, I have examined hundreds of orchards at all seasons of the year, and have incidentally made some very interesting observations on other diseases of the peach, particularly that resulting from the *Monilia*. It has also been my fortune to see this disease in the peach-belt of southwestern Michigan.

This fungus is more common, and far more destructive than any other observed on the peach in this country. It is rarely absent from the orchard, and in rainy weather it frequently destroys from one-half to three-fourths of the crop, in some cases the entire crop. Under its influence the fruit quickly loses its normal color and flavor, and becomes an entire loss to the grower. As the fungus invades the healthy tissues of the fruit the latter become leather-colored, or dark brown, and the peach is said to "rot," although, as Von Thümen first pointed out, the change is not strictly a rot. For the purposes of this paper it will, however, be convenient to follow the well-established popular usage and speak of this disease as the "peach rot."

So rapid are the changes induced by this fungus that sometimes the

greater part of entire varieties, representing thousands of dollars, may be lost in three or four days. At such times, fruit picked in an apparently sound condition is also very likely to rot on its way to market or in the hands of middlemen or consumers. Of late years peaches grown in Georgia and the far South have been especially troubled by rot during shipment. These peaches ripen in the hot weather of mid-summer and are sent long distances to Northern markets. The loss to Georgia growers is sometimes as much as two-thirds the whole crop. Could this rot be stopped the profit of peach growing the country over would be much increased—probably doubled. This general statement is based on observation and on inquiries among peach growers in a half dozen States. The peach is well known to be a delicate and perishable fruit, but it is not so generally known through just what agencies this decay occurs. An examination, however, of the fruit stalls in any city market, especially during hot and moist weather, will satisfy the most skeptical that this omnipresent fungus is the chief cause of the rapid decay, in fact, almost the sole cause.

Peaches uninjured by *Monilia* and missed in gathering sometimes hang on the trees several weeks, the skin remaining bright but the flesh becoming very soft and of a subvinous flavor. Fruit growers, as a rule, are entirely ignorant of the presence of any fungus. They do not know the cause of the rot but are painfully conscious of the result, since the latter can be expressed in pecuniary terms. The rot is frequently known as "scald" and is usually ascribed to hot and wet weather, but in this instance, as in many others, the weather is only a favoring condition, the real cause, the *sine qua non*, being the fungus, whose ash-gray spore-tufts are so often seen on the shrunken and discolored surface of the peach.

If the consensus of opinion among peach growers is of any value this rot is most uniformly destructive to early peaches, a very considerable portion of which rot every year. Whether this tendency in early varieties is due to a thinner skin, or to hotter weather during the time of their maturing, I am unable to say positively. It has been ascribed to the former and may in part be due to this, but I am not aware of any extensive series of observations made to determine the relative thickness or resisting power of peach skins. That this or some other unknown varietal peculiarity somewhat affects the spread of the disease is not improbable. I did think that certain of the early sorts, *e. g.*, Hale's Early, were specially subject to rot, but have given up this view as untenable. All the very early varieties rot badly, though in the same orchard not always to the same extent.

The well-known influence of moisture and especially of high temperature upon the rapid development of the fungus, facts which I have observed repeatedly in the orchard and have verified in the laboratory, lead me to think that the frequent rains and usual hot weather of July and the first part of August must be the principal reason why early

varieties always rot more or less, and generally much worse than middle or late sorts. It would, however, be a mistake to suppose that any variety is wholly exempt. Even sorts with the firmest flesh, *e. g.*, Troth's Early and Smock, perish very quickly if the meteorological conditions are favorable to the growth of the fungus. A single rain near the period of ripening will often immediately double or treble the number of rotting fruits.

It is also a great mistake to suppose the skin of the peach must first be punctured by insects or injured in some other way before the fungus can find an entrance. Every peach grower of long experience knows that this is not true, and any one can satisfy himself on this point by giving to the subject a little patient consideration. Injured fruits are more easily infected; that is all. In years of abundance only a small proportion of the peaches which remain on the trees are punctured by the curculio or otherwise injured, yet the entire crop may rot very quickly during a rainy period, or during a series of hot days, with occasional rains or heavy dews. Moreover, in the laboratory I have infected the soundest peaches by merely sowing a few *Monilia* spores in a drop of water upon their surface, the control spots remaining entirely sound. To be most successful this experiment must be conducted in an atmosphere nearly saturated with vapor of water and at a temperature not much below 90° F. In the laboratory, as well as in the field, an increase in temperature of 10° to 20° above the normal causes an astonishing increase in the rapidity of the rot.

Some reference to the actual losses resulting from this rot during the autumn of 1888 will serve to show what happens not infrequently, and will afford ample basis for judgment as to the economic importance of restrictive measures.

The peach crop of the Delaware and Chesapeake Peninsula is well known to have been unusually abundant in 1888. I traveled extensively in six counties and saw for myself. All varieties fruited and the orchards bent under the weight of their precious burden. Even old, broken, neglected trees, in fence rows and pastures, were full of fruit. The early and middle varieties were gathered uninjured, except by a single windstorm, and were sold at prices ranging from 50 cents to $1.25 and upwards a basket. Until the end of the first week in September there was also every prospect for a very large crop of Smock and similar productive late peaches, which are planted very extensively for drying purposes. September 7 rainy weather set in over the upper part of the Peninsula, and continued almost uninterruptedly for five or six days. When it was not actually raining it was lowering and the air was full of moisture. These remarks apply especially to the counties of Kent and Cecil in Maryland and to Kent and New Castle in Delaware. At this date the Smock peaches were almost or quite ready to pick. The weather was not excessively warm, but the rain was so nearly continuous, and the spores of the *Monilia* were so widespread, that a veritable

epiphytotic ensued.* Every day thousands of baskets of green and ripening peaches rotted upon the trees and on the way to market.

In consequence of this rot the late peaches were nowhere very profitable, and in many instances were an entire loss. The daily railroad shipments, instead of increasing with the coming on of the Smock, fell off within a few days from scores of car loads to a few dozen, and must have fallen away almost to nothing had only sound peaches been shipped. The condition of much of the fruit forwarded during this week is sufficiently characterized by the following clipping from a Philadelphia daily of September 15:

> The local peach market is utterly demoralized, not on account of the quantity of fruit but on account of the quality. No such mess called peaches was ever marketed before as has been arriving during the past few days. The season is practically ended and but few more good Delaware peaches will be received.

The total shipment of peaches over the Delaware Railway from September 9 to September 17 was but 711 car-loads; on September 14, 15, and 17, it was respectively only 46, 35, and 30 car-loads. None were shipped on Sunday, the 16th, and none of any consequence after the 17th. The shipments for four weeks previous to this time, August 13 to September 8, averaged about 195 car-loads per day. These spoiled peaches went begging at prices ranging from 7 to 25 cents per basket, the most of them being sold for 10 or 15 cents. At that time good fruit readily commanded 59 to 65 cents per basket of five-eighths bushel.

From intelligent and trustworthy peach growers on the Peninsula I have received many oral and written statements like the following, the amount of individual loss varying from a few baskets to many thousand, according to the acreage and the varieties planted:

> In my orchard in Kent County, Md., probably 500 baskets (6,000 trees). In the county at large many thousands of baskets were probably lost.—[Dr. John J. Black, New Castle, Del.]
>
> My own loss was perhaps 3,000 baskets.—[Dr. Henry Ridgely, Dover, Del.]
>
> I lost 4,000 baskets.—[Norris Barnard, Still Pond, Md.]
>
> My individual loss was not less than 2,000 baskets from an orchard of 6,000 trees.—[W. H. Burnite, Felton, Del.]
>
> I am satisfied that my loss was from 5,000 to 6,000 baskets.—[James S. Harris, Still Pond, Md.]
>
> My loss was about 7,000 baskets.—[Thomas D. France, Chestertown, Md.]
>
> I lost from 10,000 to 15,000 baskets, 3,000 baskets rotting on their way to market.—[F. H. Harper, Still Pond, Md.]
>
> In the week you speak of I lost 20,000 baskets. * * * We lost all our fruit that ripened after the Crawford's Late. The varieties lost will number at least one-half of all our orchards. In mine they represented two-thirds.—[Wilbur Eliason, Chestertown, Md.]

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*Aside from the repeated precipitation the principal peculiarity of the weather was the slight range of temperature. The variation at Dover during seventy-eight hours (a. m. of September 8 to p. m. of September 11) was only 14° F., while for the first thirty-six hours it kept between 70° and 82°, and did not at any time fall below 68°. After this the range was greater, but during the next five days the day temperature was above 70° four times and touched 83° on the 16th.

Mr. France estimates the loss in his county (Kent, Md.) at 400,000 baskets. Mr. Eliason (same county) also places the loss at 400,000 baskets. Mr. Harris (same county) thinks the loss was from one-fifth to one-sixth of the entire crop.

Norris Barnard estimates the loss on the Peninsula at one fourth of the whole crop. W. H. Burnite places the loss on the Peninsula at "one-sixth of the entire crop." Dr. Ridgely states that, at the time, the estimated money loss was $300,000.

Assuming the loss to have been only one-sixth of the total crop, and the value only 50 cents per basket, we have an approximate total loss of 800,000 baskets, worth $400,000. On first thought this seems like a rash or inflated statement. A personal acquaintance, however, with the orchards of this entire region, and a knowledge of the great extent to which Smock and other late peaches are planted, leads me to believe it is entirely warranted. In fact, it is probably under the actual loss, for in the upper part of the district in question these varieties are found in almost every orchard, while in many they include thousands of trees.*

This estimate is also established by the fact that in spite of the rot, and not counting the enormous number of peaches canned, dried, consumed, and sent away by water, the shipments from the Chesapeake and Delaware peninsula, by railroad alone, were upwards of 3,000,000 baskets (five eighths of a bushel), worth probably over $2,000,000—a crop only distanced by that of the famous year 1875, when the railroad shipments exceeded 4,500,000 baskets. But for the rot, the peach shipment of 1888 would undoubtedly have been nearly or quite equal to that of 1875, since in a productive year like 1888 the varieties which ripen after Crawford's Late are generally equal to about one-third of the whole crop.

This enormous loss of more than 800,000 baskets is to be attributed almost wholly to the destructive activity of the rot fungus. Could this fungus have been destroyed completely on the 1st day of September, or earlier in the season, the rot would not have appeared. Could it have been partially exterminated, the rot would have been proportionately less.

In this fungus the common mode of propagation from peach to peach, and the only known one, is by means of ash-gray conidia, which are produced in great numbers on the brown surface of the affected parts. These spores generally occur in little hemispherical tufts or confluent masses on bundles of hyphal threads which have burst through the skin of the peach. The mycelium ramifies abundantly in the decaying tis-

*Since this was written I have talked with Superintendent I. N. Mills, who informs me that the estimate of the railroad company's agent, after traveling over the territory in question, was 1,000,000 baskets, while the sum total of estimates sent in by the local freight agents was one-half greater. Mr. Mills himself places the loss at about 1,200,000 baskets.

sues and the number of conidial tufts visible on the surface seems to depend to a considerable extent on the amount of moisture in the air and on the length of time the peach has been affected. From these little, dusty, ash-colored tufts, which every peach grower must have observed, the infection is very readily transmitted to healthy peaches. Rains, winds, birds, insects, etc., all help to disseminate the spores and those which find suitable lodgment are very likely to germinate and extend the disease if the atmospheric conditions are at all favorable. Of course myriads of spores miscarry and other myriads perish before germination or during its progress, otherwise the peach and kindred fruits must long since have perished from the earth. Ample provision, however, has been made for the perpetuation of this parasite by endowing it with a fecundity which more than compensates for the small size and perishable nature of its spores. After some weeks, however, the conidia cease to be produced and the ash-gray tufts gradually disappear.

The disappearance of the conidial tufts is not, however, the end of the fungus. This winters over as a resting mycelium in the destroyed peaches which have either fallen to the earth or still hang upon the branches in a dry, wrinkled, mummified state. Early in the spring, if the atmospheric conditions are favorable, the fungus awakes to renewed activity—another crop of conidia is produced from new tufts borne on the old mycelium and the work of destruction begins anew. In the spring of 1889 I witnessed this for the first time, and was able to settle beyond doubt that the fungus winters over in the decayed fruits, especially in those which remain hanging upon the trees. This fact is one of great practical importance. The ordinary spores (conidia) being of a perishable nature it has occurred to many mycologists that *Monilia* must exist during a portion of the year under some other form—one capable of passing in safety through the inclement season. With this thought in mind I had been watching the fungus very narrowly for several seasons, but all to no purpose until May of this year. Then, thanks to a very rainy week, I came suddenly upon the explanation I was seeking.

Earlier in the year, when the peaches were in blossom and beginning to put forth their foliage, I was in the Delaware orchards, and was greatly perplexed to find the *Monilia* appearing suddenly everywhere on the blossoms and young fruit. This was first observed about April 29, in moist weather, soon after an unprecedentedly heavy and prolonged rain-fall.*

The orchards blossomed abundantly, but the greater part of the peach

*At Dover it poured continually for twenty hours (8 p. m. of 25th to 4 p. m. of 26th), and reports from the upper portion of the peninsula also indicated a very heavy rainfall. It also rained in showers on the 27th, all day. The precipitation at Dover from the first storm must have been at least six inches. A few peach-orchards were then in full blossom, but the majority were a day or two in advance and nearly or quite out of blossom.

crop in four counties was destroyed at this time. There had been no frosts of any consequence and the loss was generally ascribed to the rain. This was said to have washed off the pollen, but most of the orchards were just out of blossom when the rains began, and the real agent of destruction was the rot-fungus, favored, of course, by the excessive precipitation. The loss from this source in April and May, 1889, in all probability exceeded 500,000 baskets. The rot was also very bad in June and July. Hundreds of orchards in the upper portion of the peninsula produced no peaches whatever, and the railroad shipment from the whole district was only about one-half that of 1888.

Previously I was not aware that *Monilia* made its appearance so early. I had looked upon it rather as a summer or autumn fungus, but here it was in April.

Whence came the rot so suddenly? I could not tell; but in Maryland a few weeks later, during another rainy week, I saw all at once clearly what I failed to see in Delaware. This was May 16, when the young peaches were about the size of filberts or a little larger. From time to time all the winter and spring I had been inspecting the fungus-destroyed fruits of the previous season, hoping to find something. On this date I was working at another subject in a large orchard where fruit rotted the previous year. The prolonged rains had thoroughly softened the mummified peaches still clinging to the branches. Casually examining one of these, for perhaps the twentieth time, I was astonished to find its surface covered with the familiar conidial tufts. Previous to the rains I had been in that orchard, and there and elsewhere I had examined hundreds of the mummified fruits without finding a vestige of the spore-tufts of the previous summer. Indeed, the rains and winds generally destroy all traces before winter sets in, yet here they were as abundant and fresh in appearance as if grown from a newly-rotted peach. This discovery led to a careful search. On that day, and the wet ones immediately following, I found dozens of mummified fruits covered with the ash-gray tufts. In fact, about one-third of all I examined bore conidial tufts, and in no case were these the growth of the previous season. They had recently pushed from the interior of the rain-softened peaches, and they were particularly abundant after a prolonged, soaking rain. In a series of careful experiments under suitable control, I experienced no difficulty in infecting and rotting green peaches, plums, and cherries with conidia taken from these tufts. At that time, and especially some days later, great numbers of the young peaches perished from a natural infection during a continuance of the rainy weather, the mummified peaches being plentiful and their spore-dust abundant and easily disseminated.

My observations on this point confirm those made by Dr. J. C. Arthur on the cherry in 1885* and by Dr Paul Sorauer on the apple in 1889.†

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* Fourth An. Rep. N. Y. Agric. Exp. Sta. for 1885, p. 255.

†*Hamburger Garten- und Blumenzeitung*, 1889, Heft. I, p. 10–13.

They leave no doubt as to where and how this parasite passes the winter season.

This wide-spread and destructive fungus has naturally received considerable attention from mycologists, although the published accounts, especially the European, are somewhat meager. It is apparently more common and destructive in this country than in Europe, for it is not even mentioned in Winter's *Die durch Pilze verursachten Krankheiten der Kultur Gewächse*, or Von Thümen's *Die Bekämpfung der Pilzkrankheiten*. The summer form has been seen and described repeatedly, but no one has been able to connect these perishable organs with any other fungus, or to find resting spores. The cycle of development has remained hidden, and all attempts at prevention have therefore been simply gropings in the dark. Woronin has recently suggested that this fungus may be the conidial state of some *Peziza*. The fungus, for aught we know, may have an ascosporous form belonging to this or some kindred group, but such a form has never been seen and is unnecessary to the completion of its annual cycle. Moreover, if the fungus once produced asci, it may have lost this power during the lapse of ages. However this may be, it is certain that the mycelium which winters over in the dried tissues is amply sufficient to reproduce the plant each spring. This would still be true if it retained its vitality in only now and then a rotted fruit, for under favorable circumstances the mycelium in a single peach may produce a thousand or even two thousand conidial tufts, and each one is certainly capable of producing from five hundred to a thousand spores.

That the fungus may sometimes winter over in the twigs of the peach is also possible, for not only is the fruit destroyed in the manner just described, but sometimes growing shoots are also attacked and killed.

When the rot appears in the twigs it is commonly called "blight." I first discovered this blight in the summer of 1887, in Delaware, where it was unusually prevalent. Trees thus attacked present a very peculiar appearance, quite suggestive of blight in the apple and pear, only in the peach the destruction appears to be confined principally to twigs, the injury seldom extending to branches which have formed more than two annual rings. The reason for this is apparent, or at least not far to seek. Peaches are borne on very short pedicels on branches of last season's growth, and beyond their point of attachment there is usually from 3 to 18 inches of leafy elongating shoot axis, which will mature buds for the fruit and branches of the following season. In summer and autumn the blight of peach stems is always, or almost always, traceable to infection derived from mycelium. The spores do not figure here. This mycelium originates in the rotting peach; bores through the pedicel into the stem; ramifies in the latter, especially near the place of its entrance; and quickly destroys all the distal portion of the branch. Frequently the twig dies back a few inches further than the point of attachment of the peach, and sometimes a much greater dis-

tance, especially if all the foliage-bearing shoots are killed. The *direct* injury appears, however, to be confined principally to that part of the stem in the immediate vicinity of the peach. There the tissues of the stem are browned and killed by the parasite. The distal portion of the stem, the leafy shoot axis, often shows no trace of the fungus, but dries up as if girdled. Of hundreds of blighted stems examined in 1887, I saw none which were not associated with rotted peaches. Last summer and this summer I observed the same fact, although the blight was less prevalent. The earliest varieties blight most, and trees not in fruit never blight at this time of year. In the early spring, however, the young and tender shoots must be infected by spores. Many such shoots were attacked and killed in 1889.*

As a rule the fungus produces its conidial tufts much less frequently on stems than on fruit. Occasionally I have seen them on branches of the previous season's growth, but generally they are more abundant on tissues only recently out of the meristematic condition, *e. g.* on young stems in early spring.

This twig blight is well known to peach growers in Maryland and Delaware, and has been for years, although I have never seen any printed statement of the fact. In wet seasons it sometimes does more injury than the rot, because when many branches are destroyed the tree is not only injured, but the next year's crop is proportionately reduced. In some instances I have seen as many as one hundred blighted twigs on a single tree, the crown of green foliage being curiously interspersed with dead stems and withered leaves. Certain observant peach growers, to whom I mentioned the dependence of blight upon rot, assured me that they knew it already and could and did prevent it by promptly removing the rotting fruits. One man of large experience has known trees to be much injured by neglect of this precaution.

This paper, in which I have purposely avoided all questions of histology, would not be complete without some reference to means of prevention. The difficulties in the way of preventive treatment are great on account of the omnivorous nature of the fungus, yet I believe that they may be overcome and that a large measure of protection is quite within the range of possibilities.

I have quickly induced the rot in apples, pears, and peaches with spores taken from the plum; in cherries and plums with spores taken from the peach; in peaches and plums with spores taken from the cherry. The fungus infecting all these fruits is apparently one and the same. It occurs destructively on peaches, apricots, plums, and cherries, to some extent also on apples, pears, and quinces. It has also been reported as growing on grapes, gourds, the medlar, and *Cornus mas*. Dr. Arthur induced it to grow on blackberries, and Sorauer on green hazelnuts. I also found it to grow in green rose hips, but not vigorously,

* This blight must not be confused with that caused by a small larva which bores in the ends of the stems in early spring, and sometimes does considerable injury.

even under seemingly favorable conditions. The shrubby and arborescent *Pomeæ* and *Pruneæ*, especially the stone fruits, are the principal sources of infection. If we could control the disease in our orchards, the danger from outside sources would be slight.

The question of treatment naturally divides into two portions (*a*) orchard hygiene and (*b*) use of fungicides.

From what has been said it is apparent that two factors are necessary to the production of the rot:

(1) The presence of the rot fungus;

(2) The existence of meteorological conditions favorable to its rapid development.

The control of meteorological phenomena being impossible, the question arises: Can the rot be held in check by the destruction of the fungus? Fortunately we are able to give an affirmative answer. In this connection the importance of knowing where the fungus passes the winter becomes strikingly apparent. If its preservation through the winter and its reproduction in the spring depend wholly or in great part upon the existence of a dormant mycelium, then the systematic gathering and burying or burning of all rotten fruits in summer and autumn will very materially lessen the prevalence of the rot. Especially will this be true if the work of destruction is continued year after year as all work of this kind must be. The remedy here proposed rests on sound principles and is both practicable and practical. If applied on a large scale, systematically, throughout a peach district, and for a series of years, it could not fail to bring decided results. To be very successful it must be done thoroughly and by united effort. Too much stress can not be laid upon the removal and destruction of all the rotted fruits. *None must be left upon the ground or upon the trees.* Moreover, all the fruit-growers of a locality must unite if they would get the best results from this method, which is precisely that recommended for the extermination of noxious weeds, *i. e.*, allow none to go to seed.

Every husbandman knows that, in spite of thrift and painstaking, the farms of a whole community are threatened if only one man allows his fields to become the nursery of bad weeds. From the fields of this careless or negligent person the seeds of pestiferous plants are carried by animals, washed by rains, blown by winds, or transported by the hand of man outward in all directions, to curse the industrious. In the same way in dealing with this fungus one neglected orchard may furnish spores enough to reinfect all the surrounding orchards. In union only is there anything like safety. On the start it will be hopeless to expect united effort but this will come in time. Men who will not practice well-established rules of orchard hygiene ought to abandon fruit-growing. They are behind the times and in the wrong calling. Successful fruit-growing requires men of brains and decision. Prices are low, competition is severe, and, if any money is to be made, this business must be conducted intelligently in the light of all the knowledge

we can get. Even with united and unremitting zeal no more can be expected from orchard hygiene than would be anticipated from like efforts directed toward the extermination of a weed. With these provisos, it may be said that this method is full of hope. It is worth trying even if neighbors will not lend a helping hand, especially if other orchards are somewhat remote. Whether it will *pay* to struggle alone must depend on various contingencies, especially the price of fruit and the cost of labor. I am inclined to think it will, but this can be determined only by actual trial.

The proposed remedy is easy to put into operation. Every year when peaches are being picked a little additional labor would suffice to remove all the rotted and rotting peaches. The earlier this is begun the more secure will be the varieties next in order of ripening. Moreover, if at any time during the season a hot or rainy spell supervenes, and the fruit shows a tendency to rot before it is ripe, men should be put into the orchard *immediately* with instructions to remove every trace of rotting fruit. The same trees must be gone over again the next day, or the day after at furthest, so as to secure and remove all freshly rotted fruits, 24 to 36 hours being ample time to develop incipient cases not noticeable on the first gathering. The work must be done *very quickly and very thoroughly* in order that the rotting fruits may be removed and buried before the spores appear upon their surface to scatter destruction everywhere and undo all that has been done previously. Finally, in the late autumn, after the leaves have fallen, the entire orchard should be re-examined and all dried peaches lying on the earth or still clinging to the branches should be scrupulously removed and buried or burned.

I have so much confidence in the ultimate success of this method that I can not too earnestly urge its practice upon peach growers. If it were followed systematically for a series of years I believe the loss from peach rot would be reduced to inconsiderable proportions. This granted it is unnecessary to enlarge upon the resulting benefit to growers.

In regard to fungicides there is yet little to be said. Some experiments designed to preserve the fruit while on its way to market have been made by various growers. These indicate a possibility of delaying the decay some days by dipping into harmless sulphur compounds, *e. g.*, solutions of liver of sulphur, or of sulphur and cooking soda, and drying before packing into baskets for shipment. As an experiment, dry sulphur might also be dusted on the gathered fruit. All these methods are open to objection on the double score of cost and uncertainty. It is possible also that the spraying of some fungicide upon the trees and fruit will be found efficacious, but up to this time no fungicidal treatment appears to have been worked out to any satisfactory conclusion. Von Thümen recommends the repeated dry dusting of trees and fruit with sulphur, beginning in July. This might possibly answer the purpose, but the expense involved would be very considerable. So far

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we can get. Even with united and unremitting zeal no more can be expected from orchard hygiene than would be anticipated from like efforts directed toward the extermination of a weed. With these provisos, it may be said that this method is full of hope. It is worth trying even if neighbors will not lend a helping hand, especially if other orchards are somewhat remote. Whether it will *pay* to struggle alone must depend on various contingencies, especially the price of fruit and the cost of labor. I am inclined to think it will, but this can be determined only by actual trial.

The proposed remedy is easy to put into operation. Every year when peaches are being picked a little additional labor would suffice to remove all the rotted and rotting peaches. The earlier this is begun the more secure will be the varieties next in order of ripening. Moreover, if at any time during the season a hot or rainy spell supervenes, and the fruit shows a tendency to rot before it is ripe, men should be put into the orchard *immediately* with instructions to remove every trace of rotting fruit. The same trees must be gone over again the next day, or the day after at furthest, so as to secure and remove all freshly rotted fruits, 24 to 36 hours being ample time to develop incipient cases not noticeable on the first gathering. The work must be done *very quickly and very thoroughly* in order that the rotting fruits may be removed and buried before the spores appear upon their surface to scatter destruction everywhere and undo all that has been done previously. Finally, in the late autumn, after the leaves have fallen, the entire orchard should be re-examined and all dried peaches lying on the earth or still clinging to the branches should be scrupulously removed and buried or burned.

I have so much confidence in the ultimate success of this method that I can not too earnestly urge its practice upon peach growers. If it were followed systematically for a series of years I believe the loss from peach rot would be reduced to inconsiderable proportions. This granted it is unnecessary to enlarge upon the resulting benefit to growers.

In regard to fungicides there is yet little to be said. Some experiments designed to preserve the fruit while on its way to market have been made by various growers. These indicate a possibility of delaying the decay some days by dipping into harmless sulphur compounds, *e. g.*, solutions of liver of sulphur, or of sulphur and cooking soda, and drying before packing into baskets for shipment. As an experiment, dry sulphur might also be dusted on the gathered fruit. All these methods are open to objection on the double score of cost and uncertainty. It is possible also that the spraying of some fungicide upon the trees and fruit will be found efficacious, but up to this time no fungicidal treatment appears to have been worked out to any satisfactory conclusion. Von Thümen recommends the repeated dry dusting of trees and fruit with sulphur, beginning in July. This might possibly answer the purpose, but the expense involved would be very considerable. So far

as I know it has never been tried in this country on any extended scale, but some experiments made this season by J. D. Husted, of Vineyard, Ga., gave favorable results. He dusted on sulphur twice, three weeks apart, using a bellows, and making the first application when the peaches were half grown. Probably as many as four applications should be made.

On the whole, the best hope of success appears to be offered by the method first outlined, *i. e.*, the prompt and persistent removal of sources of infection by the destruction of all rotting fruit; but the two methods might be combined.

ANOTHER SPHÆROTHECA UPON PHYTOPTUS DISTORTIONS.

By Byron D. Halsted.

As an addition to the note in the Journal of Mycology (Vol. 5, No. 1) upon the *Sphærotheca phytoptophila*, K. & S., found in the buds of the distorted branches of the hackberry (*Celtis occidentalis*), it may be said that the mature perithecia of the *Sphærotheca pruinosa*, C. & P., were found in abundance in the malformed inflorescences of the common sumach (*Rhus glabra*), caused by some species of a phytoptus mite. As far as can be learned the ascigerous fruit of this *Sphærotheca* is rare, although the leaves may frequently be attacked by the mildew and abound in the conidia. What is most interesting is that the fully developed perithecia were found among the abortive flowers as early as the middle of July and at a time when no fruit of this sort need be expected upon the leaves. This is another case of the abnormally developed part of a host being the most favorable for the growth of a parasitic fungus. It is perhaps to be expected that the tissue of a plant rendered more soft and irregular upon the exposed surface would supply the conditions for a vigorous growth of a mildew that is practically superficial. The spores would more easily be held in the niches of the distorted inflorescence and find the proper conditions for a rapid growth. It is also interesting to observe that this is also another *Sphærotheca*, which genus may have a particular fondness for the distortions of mites Have other phytoptous growths been found infested with members of the *Erysipheæ?*

NORTH AMERICAN AGARICS.

Genus *Russula* (*russulus*, reddish), Fr. Hym. Eur., p. 459.

By Robert K. Macadam.

Part II.

III. RIGIDÆ.

12. "R. LACTEA, (Pers.) Fr. Hym. Eur., p. 443; Stev., B. F., p. 118; Sacc. Syll., Vol. v., p. 459. Pileus 2 inches (5 centimeters) broad, at first *milk-white, then tan-white, throughout compactly fleshy*, campanulate then convex, often eccentric without a pellicle, always dry (at first even, then slightly cracked when dry), margin straight, thin, obtuse, even; flesh compact, white. Stem 1½–2 inches (4–5 centimeters) long, 1½ inches (4 centimeters) thick, solid, very compact, but at length spongy-soft within, equal, even, always white. Gills *free*, very broad, *thick*, distant, rigid, forked, white.

"Mild, the gills are at length adnate, forked at the base and apex. Care must be taken not to confound it with other *Russulæ* which have changed color and become white. In mixed woods. Uncommon. August.

"Name *lac*, milk. Milk-white. (Fr. Monogr., ii. p. 190; B. & Br., 1133; C. Hbk., n. 621; S. Mycol. Scot., n. 591; Ag., Pers. Krombh., t. 61, f. 1–2; Barla, t. 15, f. 1–13; Paul., t. 74, f. 2.)"—Stevenson.

Edible and of good flavor. North Carolina and Pennsylvania, Schweinitz; North Carolina, Curtis; California, Harkness & Moore; Wisconsin, Bundy; Ohio, in beech woods, Morgan.

13. "R. VIRESCENS, (Schæff.) Fr. Hym. Eur., p. 443; Stev., B. F., p. 119; Sacc. Syll., Vol. v., p. 460. Pileus 2–4 inches (5–10 centimeters) broad, green, compactly fleshy, globose then expanded, at length depressed, often unequal, always dry, not furnished with a pellicle, wherefore the *flocculose cuticle is broken up into patches or warts*, margin straight, obtuse, *even;* flesh white, not very compact. Stem 1–2 inches (2.5–5 centimeters) long, ½ inch (12 millimeters) thick, solid, internally spongy, firm, *somewhat rivulose*, white. Gills free, somewhat crowded, sometimes equal, sometimes forked, with a few shorter ones intermixed, *white*.

"Edible. Taste mild. It varies in size and color of pileus, which is sometimes deep, sometimes pallid green, sometimes yellowish, then green. The gills are not so broad in front as those of neighboring species. It is very easily distinguished from all others except *R. crustosa*, by the green pileus being without a pellicle and innato-flocculose, then rivulose, and scaly in the form of patches. In woods. Frequent. July to September.—Stevenson.

"Stem variable in form, slightly reticulated with raised lines. Spores scarcely echinulate, almost globular, 6μ."—W. G. S. "Name—*Vireo*, to be green. (Fr. Mongr., ii, p. 190; Berk. Out., p. 212, t. 13, f. 6; C. Hbk., n. 632; S. Mycol. Scot., n. 592; Hussey, ii, t. 11; Ag. Schæff., t. 94, excluding f. 1; Vittad., t. 31; Sturm Deutschl, Fl., iii, 3, t. 31; Barla, t. 16, f. 10–12; Ventur., t. 17, f. 1, 2; Krombh., t. 67, f. 1–10.)"—Stevenson.

"Of various livid hues—yellow, purple, and green."—M. J. B.

"Specimens sometimes occur in which the margin is wholly or partly *striate*. The warts are sometimes pale brown."—Peck.

Of this Fries says "*antiquitus edulis*." It is about the best edible mushroom we have, tender and of a fine nutty flavor. Its greenish cap, breaking up into *areas*, distinguishing it from all others except No. 28, *R. crustosa* (also mild), which has the same habit and is sometimes greenish. *R. furcata*, also with a greenish cap, but remaining *smooth*, is easily separated by its bitter taste.

North Carolina and Pennsylvania, common, Schweinitz; North Carolina, Curtis; Massachusetts, Sprague, Farlow, Frost, Palmer; Minnesota, in woods, July, September, Johnson; New York, grassy grounds, June and July, Peck, twenty-fourth and thirty-third reports; Wisconsin, Bundy; Ohio and Kentucky, Morgan; Maryland, sometimes as large as a breakfast plate; Mississippi, Banning; New Jersey, Ellis.

14. "R. LEPIDA, Fr., Hym. Eur., p. 444; Stev., B. F., p. 119; Sacc. Syll., Vol. V, p. 461. Pileus 3 inches (7.5 centimeters) broad, *blood-red rose*, becoming pale, whitish especially at the disk, somewhat equally fleshy, convex then expanded, scarcely depressed, obtuse, opaque, unpolished, *with a silky appearance at length, often rimoso-squamulose*, margin spreading obtuse, without striæ. Stem as much as 3 inches (7.5 centimeters) long, 1 inch (2.5 centimeters) thick, *even, white or rose color*. Gills rounded behind, rather thick, somewhat crowded, often forked, connected by veins, white, often red at the edge. Edible. Taste mild; wholly compact and firm, but the flesh is cheesy, not somewhat grumous. The gills are often red at the edge, chiefly towards the margin, on account of the margin of the pileus being continuous with the gills. In mixed woods. Frequent. September to October.

"Name—*lepidus*, neat, elegant. (Fr. Monogr., ii, p. 191; Sv. ätl. Sv., t. 59; Berk. Out., p. 212; C. Hbk., n. 623; S. Mycol. Scot., n. 593; Hussey, ii, t. 32; Hogg & Johnst., t. 4; Ag. Krombh., t. 64, f. 19, 20; Batsch, t. 13, very small.)"—Stevenson.

Spores 8–10 by 6–8μ. Sacc. Syll. One of the best edible species. *R. emetica* and *R. rubra* (both poisonous) resemble this, but differ in having the pileus polished. North Carolina, in pine woods, Curtis; Massachusetts, Frost, Palmer; Minnesota, July, August, Johnson; California, Harkness & Moore; Ohio, in beech woods, Morgan; New York, generally with the pileus red, but quite variable in this respect, woods, August. Peck, forty-first Rep.

15. "R. RUBRA, Fr., Hym. Eur., 444, Stev., B. F., p. 120; Cke., iii, 1025; Sacc. Syll., Vol. V, p. 462. Pileus unicoloros, cinnabar-vermilion but becoming pale (tan) when old, disk commonly darker, compact, hard but fragile, convex then flattened, here and there depressed, absolutely dry, *without a pellicle but becoming polished-even*, often rivuloso-rimose when old, margin spreading obtuse, even, always persistent; flesh white, *reddish under the cuticle.* Stem 2–3 inches (5–7.5 centimeters) long; about 1 inch (2.5 centimeters) thick; solid, even, varying white and red. Gills obtusely adnate, somewhat crowded, whitish then yellowish, with dimidiate and forked ones intermixed. Very *acrid*, very hard and rigid, most distinct from all the others of this group in the *pileus becoming polished-even*, although without a pellicle, in the *flesh being somewhat grumous* and in the *very acrid taste.* Gills often red at the edge. In mixed woods. Frequent. August to November. Poisonous. Spores whitish. Fr.; sphæroid, 8–10μ. K. Name—*ruber*, red. (Fr., Monogr., ii, p. 191; Sv. ätl. Sv., t. 49; Berk. Out., p. 212; C. Hbk., n. 624; S. Mycol. Scot., n. 594; Ag. Decand—Barla, t. 15, f. 1–10; Krombh., t. 65; Vitt. Mang., t. 38, f. 2, not Bull; Schaeff., t. 15, f. 4–6."—Stevenson. North Carolina, Pennsylvania, Schweinitz; North Carolina, Curtis; New York, July, Peck; Massachusetts, Frost; Minnesota in woods, July and August, Johnson; Wisconsin, Bundy; California, Harkness & Moore; Maryland, Miss Banning.

16. "R. FLAVIDA, Peck, 32d Rep. N. Y. State Mus. Nat. Hist., 1879, p. 32. Pileus fleshy convex, slightly depressed, unpolished, bright yellow; lamellæ white, adnate, turning cinereous; stem yellow, solid, white at the extreme apex."—Frost, M. S.

"Pileus 1–2 inches (2.5–5 centimeters) broad, fleshy, convex, then plane or slightly depressed, yellow, becoming paler with age; flesh white, the margin at first even, then tuberculate-striate; gills nearly simple, subdistant and broader before, adnate, white, the interspaces venose; stem 1–2 inches (2.5–5 centimeters) long, $\frac{1}{3}$–$\frac{1}{2}$ inch (8–12 millimeters) thick, short, equal or tapering upward, firm, glabrous, solid or merely spongy within, yellow; spores globose, 6–7.5μ in diameter.

"Taste mild. Gregarious. Grassy places in copses and open woods. Sandlake. July and August. The pileus is dry, and sometimes slightly mealy or granular. When young it is bright yellow; but it fades with age, and sometimes becomes white on the margin."—Peck.

This is one of the species found by Mr. Frost, but never published by him. Massachusetts, Frost; New York, Peck. Thirty-second Report and Bulletin, 1887.

17. "R. CINNAMOMEA, Miss M. E. Banning, Bot. Gaz., Jan., 1881. Pileus 4–6 inches (10–15 centimeters) broad, dry, fleshy, centrally depressed, cinnamon color, rimoso-squamose, the cuticle generally breaking up into flocci or granules; flesh dry, spongy, tinged with ocher. Gills concoloros, narrow, forked, close, sinuate near the margin. Stem 2–3 inches (5–7.5 centimeters) or more long, 1 inch. (2.5 centimeters)

thick, regular, smooth, pallid, blunt, at first stuffed, then hollow; spores globose, 8μ in diameter. Taste acrid. In woods near Baltimore. June and July."—Ban.

IV. HETEROPHYLLÆ.

18. "R. VESCA, Fr., Hym. Eur., p. 446; Stev., B. F., p. 122; Sacc. Syll., Vol. V, p. 465. Pileus *red-flesh color*, *disc darker*, fleshy, slightly firm, plano-depressed, *slightly wrinkled with veins*, with a viscid pellicle, margin at length spreading; flesh cheesy, firm, shining white. Stem *solid*, compact, externally rigid, *reticulated and wrinkled* in a peculiar manner, often attenuated at the base, shining white. Gills adnate, crowded, thin, shining white, with many unequal and forked ones intermixed, but scarcely connected by veins. Of middle stature. Taste mild, pleasant. In mixed woods. Frequent. September to October. Name, *vesco*, to feed. From its edible qualities. (Fr., Monogr., ii, p. 193; Sv. ält. Sv., t. 63; Berk. Out., p. 211; C. Hbk., n. 625; S. Mycol. Scot., n. 596; Hussey, i, t. 89.)"—Stevenson.

An edible species of fine flavor. Its peculiarly reticulated stem will assist in separating it from the noxious *R. rubra* which resembles it in the color of the pileus. California, Harkness & Moore.

19. "R. CYANOXANTHA, (Schæff.) Fr., Hym. Eur., p. 446; Stev., B. F., p. 122; Sacc. Syll., Vol. V, p. 465. Pileus 2–3 inches (5–7.5 centimeters) and more broad, *lilac or purplish*, *then olivaceous-green*, disc commonly becoming pale, often yellowish; *margin* commonly *azure-blue or livid purple*, *compact*, convex, then plane, then depressed or infundibuliform, sometimes even, sometimes wrinkled or streaked, viscous, margin deflexed, then expanded, remotely and slightly striate; flesh firm, cheesy, white, commonly reddish beneath the separable pellicle. Stem 2–3 inches (5–7.5 centimeters) long, as much as 1 inch (2.5 centimeters) thick, *spongy-stuffed*, but firm, often cavernous within when old; equal, smooth, *even*, shining white. Gills rounded behind, connected by veins, not much crowded, broad, forked with shorter ones intermixed, shining white.

"Allied to *R. vesca* in its *mild*, pleasant *taste*, and in other respects, but constantly different in the color of the pileus, which is very variable, whereas in *R. vesca* it is unchangeable. The peculiar combination of colors in the pileus, though very variable, always readily distinguishes it. In woods, etc. Common. August to October. Sometimes considerably larger than Fries describes. Name, κύανος, blue; ξανθός, yellow. From the colors. (Fr., Monogr., ii, p. 194; B. and Br., n. 1131; C. Hbk., n. 626; S. Mycol. Scot., n. 597; Ag. Schæff., t. 93; Krombh., t. 67, f. 16–19; Paul., t. 76, f. 1–3.)"—Stevenson.

"One of the best esculent species. Spores 8–10 by 6–8μ." Sacc. Syll. "Intrinsically a margin with a rosy tone, more or less sobered with purple, a pale disk and between the two a dark zone of dull indefinable mixture of neutral green with purple, is the type, and the infinite variety is made up not of any change of colors, but simply of

their intensity."—Cooke. North Carolina and Pennsylvania. Common—Schweinitz.

20. "R. HETEROPHYLLA, Fr., Hym. Eur., p. 446; Stev., B. F., p. 123; Sacc. Syll., Vol. V, p. 465. Pileus very variable in color, but *never becoming reddish or purple*, fleshy, firm, convexo-plane, then depressed, *even polished*, the very thin pellicle disappearing, margin thin, even or densely but slightly striate; flesh white. Stem solid, firm, somewhat equal, *even* shining white. Gills *reaching the stem in an attenuated form, very narrow, very crowded*, forked and dimidiate, shining white. Taste *always mild*, as in *R. cyanoxantha*, from which it differs in its smaller stature, in the pileus being thinner, even, *never reddish* or purplish, with a thin, closely adnate pellicle, in the *stem* being *firm and solid*, and in the *gills* being *thin, very narrow, very crowded*, etc. The apex of the stem is occasionally dilated in the form of a cup, so that the gills appear remote. In woods. Common. July to October.

"Edible, of a sweet nutty flavor. Spores echinulate, 5 by 7 μ."—W. G. S. "Name, *Ετερος*, other, *ρύλλον*, a leaf. With *gills of different* lengths. Fr.,) Monogr., ii, p. 194; Berk. Out., p. 211, t. 13, f. 5; C. Hbk., n. 627; S. Mycol. Scot., n. 598; Hogg. & Johnst., t. 9; Hussey, i, t. 84; Badh., i, t. 10, f. 3; ii, t. 3, f. 3, 4; Ag. Gl. Dan., t. 1909, f. 1; Paul., t. 75, f. 1-5)."—Stevenson.

Of the same edible qualities as the preceding; sometimes of a greenish-gray color. *R. furcata*, the only species of a disagreeable flavor having a green pileus, is distinguished by its uniform color and distant gills, as contrasted with the mottled tints and crowded gills of the former. North Carolina and Pennsylvania, in moist woods (*A. lividus*, Pers.) Schweinitz; California, Harkness and Moore; New York, in woods, August, Peck Thirty-fifth Report; Massachusetts, Palmer.

21. "R. CONSOBRINA, Fr., Hym. Eur., p. 447; Stev., B. F., p. 123; Sacc. Syll, Vol. V, p. 466. Pileus 3 inches (7.5 centimeters) broad, *dark-cinereous* or fuscous-olivaceous, fleshy, fragile, campanulate then expanded, at length depressed, margin spreading, even, though membranaceous; *flesh—white, cinereous, under the thick, viscous*, separable *pellicle*. Stem 2–3 inches (5–7.5 centimeters) long, almost 1 inch (2.5 centimeters) thick, solid, but *soft*, equal, even, smooth, shining, white, *at length becoming cinereous*. Gills at the first free, then appearing adnate when the pileus is flattened, broad, crowded, shining, white, *very many of them dimidiate and forked. Taste very acrid.* Not fetid. Stature in general that of *R. emetica*, but differing in the color of the pileus, and in the very unequal gills. In mixed woods. October. Spores granular 10μ. Q. Name—*consobrinus*, cousin. Distantly related to neighboring species. (Fr., Monogr., ii, p. 195; B. & Br., n. 1676; S. Mycol. Scot., n. 599.)"—Stevenson.

New York. "Our specimens are very variable in color, but the prevailing hues are green, olivaceous, and purple."—Peck. Twenty-sixth Report.

22. "R. FOŒTENS, (Pers.) Fr., Hym. Eur., p. 447; Stev., B. F., p. 124; Sacc. Syll., Vol. V, p. 467. Pileus 4–5 inches (10–12.5 centimeters) and more broad, dingy yellow, often becoming pale, thinly fleshy, at first bullate, then expanded and depressed, covered with a pellicle which is adnate, not separable and viscid in wet weather, margin broadly membranaceous, at first bent inwards *with ribs which are at length tubercular;* flesh thin, *rigid*—fragile, pallid. Stem 2 inches (5 centimeters) and more long, ½–1 inch (1–2.5 centimeters) thick, stout, stuffed, then hollow, whitish. Gills adnexed, crowded, connected by veins, with very many *dimidiate and forked* ones intermixed, whitish, at first *exuding watery drops.*

"Fetid. *Taste acrid.* Very *rigid*, most distinct from all others in its *very heavy empyreumatic odor.* In very dry weather the odor is often obsolete. The margin is more broadly membranaceous and hence marked with *longer furrows* than in any other species. It differs from all the preceding ones in the gills at the first exuding watery drops. The gills become obsoletely light yellow, and dingy when bruised."—Stevenson. "In woods, etc. Very common. July to September. Stem ruggedly hollow within as if eaten by snails."—M. J. B. "A very coarse and easily recognized species. Reckoned poisonous, though eaten by slugs. Spores minutely echinulate, almost globular 8*μ*."—W. G. S. "Name—*fœtens*, stinking. (Fr. Mongr., ii, p. 195; Sv. ätl. Sv., t. 40; Berk. Out., p. 213; C. Hbk., n. 628; S. mycol. Scot., n. 600; Ag. Pers.—Krombh., t. 70, f. 1–6; Viv., 41; Bull., t. 292; Ventur., t. 33, f. 1–3.)"—Stevenson.

"Variety *granulata* has the cuticle of the pileus rough with small granular scales."—Peck, Thirty-ninth Report. "The odor of this plant as it occurs with us is not usually fetid or unpleasant. It resembles the odor of cherry bark and might aptly be termed amygdaline, and the same odor has been attributed by one writer at least to the European *R. fœtens.* It is doubtless this form to which Dr. Curtis gave the name *R. amygdalina.* The lamellæ are rarely forked and frequently are quite as equal as in species of the section Fragiles."—Peck, Thirty-second Report.

North Carolina and Pennsylvania, plentiful, August, Schweinitz; North Carolina, Curtis; Massachusetts, Sprague, Frost; New York, common in woods and open places, July and August, Peck, Twenty-third Report; Minnesota, July to September, Johnson; Wisconsin, Bundy; Ohio, generally rancid and stinking, sometimes fragrant, common, Morgan; Rhode Island, Bennett.

23. "R. SIMILLIMA, Peck, 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 75; Sacc. Syll., Vol. V, p. 467; pileus, 1–3 inches (2.5–7.5 centimeters); broad, hemispherical or convex, then expanded, slightly depressed; at first or when moist viscid; the margin at length tuberculate-striate; pale, ochraceous yellow, the disk usually a little brighter colored; gills subequal, reaching the stem, some of them forked behind, venose connected, yellowish from the first; stem 2–4 inches (5–10 cen-

timeters) long, $\frac{1}{3}$–$\frac{3}{4}$ inch (8–18 millimeters) thick; equal or slightly tapering upward, spongy within, rarely hollow, colored like the pileus, sometimes a little paler; spores, $\frac{1}{3000}$ inch (8 μ) in diameter; taste acrid. Ground in woods."—Greig. September.

"Allied very closely to *R. fœtens*, from which it differs by the absence of any marked odor and the margin not so widely striate. I have never seen it cæspitose; not growing in cleared lands."—Peck. Massachusetts, Frost; Wisconsin, Bundy.

24. "R. MORGANI, Sacc. Sylloge, Vol. V, p. 468. (*R. incarnata*, Morgan.) Pileus 3–4 inches (7.5–10 centimeters) broad, fleshy, firm; then very fragile, convexo-umbilicate; then expanded and depressed, moist, sordid, flocculose; the margin acute, not striate; the flesh thin, white. Stem about 2 inches (5 centimeters) long, $\frac{3}{4}$ inch (18 millimeters) thick, solid, nearly equal, white. Gills adnate, distant, broad, and alternate ones dimidiate or mostly very short, white, then pale flesh color. Spores white, oblique, apiculate, smooth; 8–5.5μ.

"Taste mild. On the ground, under beech trees. July, August. The pileus is at first of a sordid color, brownish on the disk. The whole plant when mature takes on a sordid, fleshy hue, and becomes exceedingly fragile."—Morg.

Originally published as *R. incarnata* by Prof. A. P. Morgan in The Mycologic Flora of the Miami Valley, Ohio, (Journ. Cinn. Soc. Nat. Hist., April, 1883), but the title being preoccupied it was renamed as above.

25. "R. VARIATA, Miss M. E. Banning, Bot. Gaz., Jan., 1881. Pileus 3–4 inches (7.5–10 centimeters) broad, at first globose, then expanded and centrally depressed, smooth, viscid, variable in color and even variegated brownish or pinkish purple, with at times a cast of green; epidermis peels easily; the extreme under margin edged with a delicate line of purple; flesh white, unchanging. Gills white, adnexed, narrow, forked, close. Stem nearly 2 inches (5 centimeters) long, $\frac{3}{4}$ inch (18 millimeters) thick, white, smooth, more or less tapering at the base, spongy within; spores white, echinulate, 7.5 by 7.5μ. Taste acrid. In woods near Baltimore. July."—Ban.

(*To be continued.*)

A NEW MUCRONOPORUS.

(Plate XII.)

By J. B. ELLIS AND B. T. GALLOWAY.

MUCRONOPORUS EVERHARTII. On living trunks of *Quercus nigra*, around Newfield, N. J. Found also by Mr. Everhart at West Chester, Pa., and sent from northern New Jersey by Prof. T. G. Gentry. Pileus dimidiate, zonate unguliform, broadly attached behind, convex above,

nearly plane below or convex behind and subconcave towards the margin, 6–12 centimeters wide and 6–8 centimeters long; margin subobtuse and clothed with a rich dark rhubarb-yellow thin tomentum, at length subglabrous. Pileus with 3–4 broad (2 centimeters) convex zones, the anterior margin of each zone disappearing beneath the posterior margin of the one before it, forming a concentric furrow between each two contiguous zones; surface crustaceous but not polished, becoming brownish black. Pores rhubarb-yellow with a changeable luster, equal, round, 110–120 μ in diameter, about 1 centimeter long, substratose, armed with abundant stout spines, 15–25 by 6–10 μ, mostly swollen at the base. Spores ferruginous, globose 3–3½ μ, or ovate-globose 3½–4½ by 3–3½ μ. Substance of the pileus (above the pores) corky leathery, rhubarb-yellow, repeatedly zoned, 2–3 centimeters thick, holding its thickness well towards the margin. The pores are not decurrent but are limited behind by a narrow definite margin; closely attached to the bark of the tree. What appears to be the same was found some years ago at Potsdam, N. Y., on beech. This differs from *Fomes rimosus*, Berk. in its pileus not rimose, in its rather smaller spores and spiny hymenium. In *M. igniarius* the spines are less abundant and shorter and spores hyaline.

NEW SPECIES OF KANSAS FUNGI.

By J. B. Ellis and W. A. Kellerman.

Phyllosticta viridis, *n. s.* On leaves of *Fraxinus viridis*, Rooks County, Kansas, September, 1888; (E. Bartholomew, 185). On large subindefinite (½–1 centimeter) spots visible on both sides of the leaf with a paler shaded margin. Perithecia hypophyllous, numerous, suberumpent, small, 65–80μ, of rather coarse cellular structure; sporules abundant, oblong, minute (2 by ½μ). The spots much resemble those of *P. fraxini*, E. & M., but that has sporules 5–7 by 2½–3μ and much larger epiphyllous perithecia.

Cytispora albiceps, *n. s.* On bark of *Juglans nigra*, Manhattan, Kans., March, 1889 (Kellerman & Swingle, 1393). Tubercles semiemergent, gregarious, ½ to ¾ millimeter, depressed-conic, opening by a single pore at the obtuse apex, which is covered with white granular matter, 5–6-celled, the cells at first filled with white granular matter and not readily distinguished. Sporules allantoid 4–7½ by 1¼–2μ. Basidia? Much resembles *C. leucophthalma*, B. &. C., but the specimens of that species in Rav. F. Am., 698, have the tubercles less prominent and smaller and the sporules smaller (3-4 by 1μ). This also differs from *C. persicæ*, Sz., and *C. leucostoma*, Sacc.

Ascochyta sisymbrii, *n. s.* On *S. canescens*, Manhattan, Kans. (Kellerman & Swingle, 1221). Spots none; Perithecia scattered on

both sides of the leaf and on the petioles, black, innate, globose-depressed, 200–285μ in diameter, 100–195μ high, pierced above with an aperture about 20–25μ in diameter. Sporules vermiform-cylindrical, subhyaline, nucleate and mostly 1-septate, 18–45 by 3½–6μ, mostly 25–38 by 4–5μ. Not to be confounded with *Septoria sisymbrii*, Ell., which is on spots and has smaller spores.

SEPTORIA APARINE, *n. s.* On the lower dead and withered leaves and stems of *Galium aparine*, Manhattan, Kans., May, 1888 (Kellerman & Swingle, 1223). Perithecia minute, mostly 40–80μ but sometimes 160–208μ in diameter, scattered on the leaves and stems but not on spots. Sporules filiform, straight or subundulate, faintly nucleolate, continuous, acute at each end, 40–80 by 1½–2μ mostly 50–60 by 2μ. Differs from *S. psilostega*, E. & M., in not being on spots and in its shorter sporules and from *S. galiorum*, Ell. in its partially foliicolous growth, smaller perithecia and much longer spores.

AMEROSPORIUM SUBCLAUSUM, *n. s.* On fallen leaves of *Gymnocladus Canadensis*, May, 1888 (Kellerman & Swingle, 1232). Amphigenous, scattered; perithecia black, ovoid-globose 90–150μ in diameter, of coarse cellular structure with a round opening above fringed with spreading brown septate hairs, 60–220 by 5–8μ tapering above. Sporules oblong-cylindrical, obtuse, continuous, hyaline, 10–13 by 2–3μ. Differs from *A. polynematoides*, Speg. in the character of the perithecia.

PESTALOZZIA UNCINATA, *n. s.* On dead leaves of *Quercus tinctoria* dried up on broken limbs, St. George, Kans., June, 1888 (Kellerman & Swingle, 1269), with *Chætophoma maculosa*, Ell. & Morgan. Hypophyllus, gregarious, perithecia scutate, ¼ to ¾ millimeter in diameter. Spores oblong, pale, 4-septate, sometimes constricted at the second septum above, 18–22 by 5–7μ, with a short (5–7μ), stout, curved beak at the apex and a slender pedicel below 15–20μ long. Differs from *P. pallida*, E. & E., in its larger perithecia and spores.

BOTRYTIS HYPOPHYLLA, *n. s.* On living leaves of *Teucrium Canadense*, Manhattan, Kans., October, 1884 (M. A. Carleton, 142). Forming small white patches at first, soon effused over the entire lower surface of the leaf like a white tomentum. Prostrate hyphæ loosely interwoven, branching; fertile hyphæ erect, 30–150 by 2½–3μ, continuous, hyaline, subverticillately or rarely dichotomously branched above, the tips muriculate-lobate and bearing the globose 3½–4½μ conidia. *Cercospora ferruginea*, Fckl. occurs on the same leaves.

BOTRYTIS CINEREO-GLAUCA, *n. s.* On wood under the bark of decayed logs of *Ulmus Americana*, Manhattan, Kans., March, 1889 (Kellerman & Swingle, 1422). Forming a cinereous and somewhat glaucous continuous layer on the decaying wood under partially adhering bark. The repent hyphæ are branched and loosely interwoven, 2–2½μ wide, septate, sometimes slightly swollen above the septa, varying from nearly hyaline to somewhat dusky. Fertile hyphæ erect, 75–100 by 1½–2½μ wide, hyaline or somewhat dusky at base, at first sparingly and

later abundantly and irregularly branched, the branches usually straight and slightly tapering upward, terminated by a small cluster of oval-oblong 3–5 by $1\frac{3}{4}$–$2\frac{1}{4}\mu$ hyaline conidia.

OVULARIA CARLETONI, *n. s.* On *Lactuca*, Mitchell County, Kans., June, 1886 (M. A. Carleton, 141). Hypophyllous forming patches more or less distinctly limited by the veinlets 2–4 millimeters in diameter and of a pale yellowish color. The leaf is also marked on the upper side with pale yellowish indefinite spots. Hyphæ hyaline, 25–35 by 4–5μ, with offsets or shoulders on the sides marking the points where the conidia were attached, closely aggregated in minute tuberculiform masses. Conidia oblong-elliptical, hyaline, continuous, 12–15 by 6–7μ.

CERCOSPORA BARTHOLOMEI, *n. s.* On *Rhus toxicodendron*, Rooks County, Kans., September, 1888 (E. Bartholomew, 183 and 248*a*). Hypophyllous in inconspicuous, indeterminate, smoky-colored, scattered or subconfluent patches. Hyphæ fasciculate, straight or subundulate, nucleate, continuous or sparingly septate, reddish brown (under the microscope) 20–40 (mostly 24–34) by 4–6μ sometimes branched from near the base, tips entire or subdentate. Conidia nearly hyaline, varying from oblong to slender obclavate and from 20–120μ long and $2\frac{1}{2}$–3μ wide, nucleate becoming 3–8-septate, the shorter ones straight, the longer ones a little curved. This is very different from *C. toxicodendri*, Ell.

MACROSPORIUM BACCATUM, *n. s.* On old nuts of *Æsculus arguta*, Manhattan, Kans., March 1888 (Kellerman & Swingle 1239). Forms a dark olive thin but compact velvety coat on the nut. Fertile hyphæ sparingly branched or simple; torulose, 5–8μ in diameter, the joints occasionally swollen at intervals, nucleate. Conidia terminal, composed of rather loosely aggregated sub-globose cells, having an irregularly lobulated outline, somewhat resembling the fruit of a blackberry, very variable in shape and size, 16–40 by 8–27μ, usually without pedicels.

ZIGNOELLA DIAPHANA, (C. & E.). Sacc. var GRACILIS, *n. var.* On decayed log, Manhattan, Kans., June, 1888 (Kellerman & Swingle 1249). The sporidia are acutely elliptical, 3–4-nucleate, hyaline 11–$12\frac{1}{2}$ by 5–6μ, and like those in our specimens of *Z. diaphana* (although Saccardo, in Syll. II, 220, gives the size as 20 by $7\frac{1}{2}\mu$), but the asci, which are 75–87 by 6–9μ, are larger; and the perithecia, which are mostly 120–240μ in diameter, and globose-conic or subrostrate, are smaller and more acute. Possibly it should be assigned specific instead of varietal rank.

NEW AND RARE SPECIES OF NORTH AMERICAN FUNGI.

(*Sphæropsideæ.*)

By J. B. Ellis and B. M. Everhart.

Phyllosticta pyrolæ, *n. s.* On living leaves of *Pyrola rotundifolia*, Centreville, Del., July, 1873. A. Commons, 906. Spots amphigenous reddish brown, orbicular with a narrow, slightly raised margin, 1½–2 millimeters in diameter. Perithecia epiphyllous, erumpent, globose, 100–112μ in diameter. Sporules ovate-globose, hyaline, 5–6μ in the longest diameter.

Phyllosticta humuli, Sacc. & Speg. var. major, E. & E. On hop leaves, Iowa, June, 1889, A. S. Hitchcock. Differs from the type in its larger (12–16μ) sporules. Spots dull rusty white, becoming whiter, 2–3 millimeters in diameter, suborbicular, with a narrow, raised border. Perithecia epiphyllous, innate, yellowish, (80-90μ). Sporules 12–16 by 4–5μ with 1–3 nuclei.

Phyllosticta rhei, *n.s.* On *Rheum officinale*, Newfield, N. J., August, 1889. Spots mostly marginal, subconfluent, large (1–2 centimeters), rusty brown, concentrically zoned, either with or without a definite, slightly darker limiting line, around which is a broad border of light yellow. Perithecia innate, visible on both sides of the leaf and slightly prominent, rather large (100–150μ), not abundant. Sporules oblong-elliptical, 2-nucleate, rounded at the ends, hyaline, 5–7 by 2–2½μ, resembling the sporules of some *Phoma*.

Phyllosticta variegata, *n. s.* On leaves of *Fraxinus*, London, Canada, July, 1889. J. Dearness, 519. Spots numerous, angular, pale yellow, 1–3 millimeters in diameter, with a definite, narrow, darker margin. Perithecia epiphyllous, lenticular, black, 90–100μ. Sporules ovate or elliptical 4–5 by 1½–2μ. *Phyllosticta fraxini*, E. & M., which is doubtfully distinct from *P. fraxinicola*, Curr., has larger sporules (5–7 by 3μ) and larger darker spots. *P. viridis*, E. & K., is also quite different from this.

Phyllosticta macluræ, *n. s.* On leaves of *Maclura aurantiaca*, Newfield, N. J., August, 1889. Spots dark red-brown, subirregular and subindefinite, often marginal and confluent, ¼ to 1 centimeter in diameter. Perithecia epiphyllous, prominent, ⅓ millimeter in diameter. Sporules ovate-oblong or fusoid-oblong 2–4-nucleate 10–12 by 3μ.

Phyllosticta calaminthæ, *n. s.* On *Calamintha clinopodium*, London, Canada, August, 1889. J. Dearness, 372. Spots amphigenous, definite, round 1–2 millimeters in diameter, nearly black, becoming whitish, thin. Perithecia few lenticular, epiphyllous, pierced above, 80μ in diameter. Sporules elliptical, hyaline, 2-nucleate, 3½–4½ by 2–2¼μ.

Phyllosticta hydrangeæ, *n. s.* On leaves of *Hydrangea* (cult.). Spots 1½ to 1 centimeter or more in diameter, rusty brown, with a nar-

row raised border, shaded with purple at first. Perithecia epiphyllous, lenticular, pierced above 100–115μ in diameter. Sporules oblong, 2–3-nucleate, hyaline, 10–12 by $2\frac{1}{2}$–$3\frac{1}{2}\mu$.

PHYLLOSTICTA ORONTII, E. & M. var. ADVENA, E. & E. On leaves of *Nuphar advena*, London, Canada, July, 1889. J. Dearness, 293½. Spots subelliptical 1–1½ centimeters, pale yellow, more or less concentrically wrinkled, with a narrow, definite, slightly raised border. Perithecia epiphyllous, innate, dark, slightly prominent, on a lighter colored, thinner, definitely margined spot in the center of the larger spot. Sporules oblong, 5–8 by $2\frac{1}{2}$–3μ, ends obtuse.

PHYLLOSTICTA HALSTEDII, *n. s.* On living leaves of *Syringa vulgaris*, New Brunswick, N. J., July, 1889. Dr. B. D. Halsted. Spots amphigenous; subrotund; red-brown; ¼ to 1¼ centimeters in diameter; concentrically wrinkled or zoned, with a definite, narrow, dark border. Perithecia few; lenticular 100–150μ, in diameter; innate; generally visible on both sides of the leaf. Sporules broad, fusoid-oblong, not curved; granular; 15–20 by 5–7μ; ends rounded. The specimens of *Phyllosticta syringæ*, West, in De Thümen's Mycotheca 1490 agree very well with the description in Sylloge, having sporules 6–8 by $2\frac{1}{2}$–3μ, but specimens in Fungi Gallici 135 are the same as the New Jersey specimens; spots concentrically wrinkled, and sporules 15–20 by 5–7μ. De Thümen's Mycotheca, 1672, on leaves of *Syringa Chinensis*, does not seem to be a *Phyllosticta*.

PHYLLOSTICTA DESMODII, *n. s.* On leaves of *Desmodium*, Walworth County, Wis. July, 1888. Dr. J. J. Davis, 47. Spots amphigenous, suborbicular or irregular; 2–5 millimeters in diameter; often more or less confluent; dark brown, becoming whitish in the center, at length more or less fissured and cracked. Sporules oblong, elliptical, hyaline, $3\frac{1}{2}$–5 by $1\frac{1}{2}$–2μ.

PHYLLOSTICTA PALMETTO, *n. s.* On leaves of *Sabal palmetto*, Louisiana, April, 1886. (Langlois, 426 in part.) On the same host at Leland, Miss., April, 1889 (Tracy, 1206). Spots subelliptical ½ to 1 by ¼ to ½ centimeter, pallid, with a yellowish shaded border. Perithecia amphigenous, pustuliform, 110–150μ in diameter, lead colored, of fine cellular structure, with a small round opening in the center. Sporules cylindrical; obtuse 2–3-nucleate, hyaline, 12–14 by $2\frac{1}{2}$–3μ. The perithecia resemble minute blisters. Probably the spermogonial stage of *Sphærella sabaligena*, E. & E., with which it was mixed in the Louisiana specimens.

PHYLLOSTICTA DEUTZIÆ, *n. s.* On leaves of *Deutzia* (cult.). Spots amphigenous, light brown or whitish, round, 1–2 millimeters in diameter, with raised border on both sides of the leaf. Perithecia lenticular, black, mostly epiphyllous, nearly superficial, ⅕ millimeter in diameter. Sporules subelliptical, fuscous, 4–5 by 3μ.

PHYLLOSTICTA COMMONSII, *n. s.* On leaves of *Pæony*, Wilmington, Del., June 24, 1889. A. Commons, No. 922. Spots pale yellowish, defi-

nite, 3–4 millimeters in diameter. Sporules oblong or elliptical, smoky hyaline, 4–5 (exceptionally 6–7) by 2–2½ μ. Differs from *P. pæoniæ*, S. & S., in its definite spots and smaller (75–80 μ) perithecia and in its smaller sporules.

MACROPHOMA SUBCONICA, *n. s.* On dead stems of *Solanum nigrum*. St. Martinsville, La., November, 1888. Rev. A. B. Langlois, 1569. Perithecia innate-erumpent, conical, ½ to 1 millimeter high. Sporules elliptical, hyaline, 20–2? by 14–16 μ. On slender basidia about as long as the sporules. Also on *Alocasia esculenta*, No. 1576.

PHOMA MEDIA, *n. s.* On dead stems of *Asparagus*, Newfield, N. J., April, 1889. Perithecia occupying an elongated spot 6–8 centimeters long and 1 centimeter wide, large (½ millimeter), depressed-globose, or slightly oblong, with a distinct papilliform ostiolum which is soon broadly perforated. Sporules fusoid, straight, hyaline, 2-nucleate, acute, about 10–12 by 2½ μ. *P. asparagi*, Sacc., is on bleached parts of the stem and has smaller obtuse sporules. In this the surface of the stem beneath the leaden-colored epidermis is more or less blackened. *P. lanceolata*, (C. & E.) has the sporules 20–24 by 5 μ.

SPHÆRONEMA CANUM, *n. s.* On dead branches of *Negundo aceroides*, Manhattan, Kans., February, 1889. Kellerman & Swingle, 1318. Perithecia at first covered by the bark, depressed hemispheric, 1 millimeter or over in diameter, with a central, cylindrical, stout, straight, black beak about 1 millimeter high with a slightly enlarged, subovate, gray, strigose head. Sporules ovate-olong or ovate-elliptical, nucleate, hyaline, 7–10 by 3–4 μ, on cylindrical basidia 15–20 by 2 μ, and forming a compact, whitish horn-colored stratum within the perithecia. The general appearance of the fungus is much like that of *Stilbum giganteum*, Pk., or perhaps resembles more closely *Sphæronema pruinosum*, Pk., but this is quite distinct from either of those species.

HAPLOSPORELLA EUONYMI, *n. s.* On dead limbs of *Euonymus atropurpureus*, Lincoln, Nebr., March, 1889; H. J. Webber. Stromata scattered or seriate, erumpent, and loosely surrounded by the ruptured epidermis, hemispheric or oblong, 1–2 millimeters in diameter, subtruncate, and finally whitish above. Perithecia entirely inclosed in the stroma, with thin subevanescent walls, and appearing on a cross-section more like cells than like perithecia; ostiola obscurely papilliform. Sporules oblong, obtuse, very slightly narrowed in the middle (possibly becoming 1-septate), 10–14 by 6–8 μ, brown, on slender basidia, 70–80 μ, long. On the smaller twigs the stromata are smaller, but the sporules larger, 18–22 by 10–12 μ. *Sphæropsis valsoidea*, (C. & E.) has exactly the same structure and should be *Haplosporella valsoidea*, C. & E.

HAPLOSPORELLA AILANTHI, *n. s.* On dead *Ailanthus glandulosus*, Lyndonville, N. Y., May, 1889; Dr. C. E. Fairman, 61. Perithecia large (¾ millimeter); aggregate cespitose, buried in the bark and connected by an imperfect stroma, subseriately erumpent. Sporules ovate or elliptical, dark brown, 18–22 by 8–10 μ, filled with white grumose matter.

ASCOCHYTA SILENES, *n. s.* On leaves and stems of *Silene antirrhina*, Racine, Wis. June 1888, Dr. J. J. Davis, 23, and on the same host collected by Mr. F. W. Anderson (No. 350) in Montana. Spots pale yellowish, the entire leaf finally assuming the same color, the spots which are then hardly discernible becoming paler. Perithecia erumpent discoid, 120–150μ in diameter, broadly pierced above, not confined to the spots but scattered over the entire leaf. Sporules oblong, hyaline, 2–3 nucleate, rounded at the ends 10–14 by 2½–3μ. In the Wisconsin specimens *Septoria saponariæ*, (D C.) occurs also on the same leaves, but may be distinguished with the naked eye by its paler perithecia. This differs from *Phyllosticta nebulosa*, Sacc., in its larger scattered perithecia and larger sporules. The specimens of *P. nebulosa* in Saccardo's Mycotheca Veneta (in our copy) are a *Sphærella* with clavate-oblong, inequilateral 35 by 15μ asci and crowded, oblong-fusoid 1-septate 12–15 by 3–3½μ sporidia.

ASCOCHYTA? INFUSCANS, *n. s.* On leaves of *Ranunculus* (*abortivus?*), London, Canada, July 18, 1889; J. Dearness, 256. On large, dark brown, indefinitely limited areas of the leaf, causing faintly zonate indefinite spots, in which are buried the brown perithecia, slightly raising the surface of the leaf in a pustuliform manner. Sporules oblong, hyaline, obtuse, narrowed in the middle, with two large nuclei 10–15 by 4–6μ (becoming uniseptate?).

ASCOCHYTA THASPII, *n. s.* On leaves of *Thaspium barbinode*, London, Canada, August, 1889; J. Dearness, 511. Spots amphigenous, suborbicular, dirty brown, with definite margin, surrounded by a narrow yellow border, about 1½ centimeters in diameter. Perithecia innate, pale, 100–120μ in diameter, entirely buried in the substance of the leaf and scarcely visible. Sporules cylindrical 1-septate (3–4 nucleate), 25–30 by 6–8μ, ends rounded and obtuse.

ASCOCHYTA ALISMATIS, *n. s.* On leaves of *Alisma plantago*, London, Canada, August, 1889; J. Dearness, 512. Spots amphigenous, round, small (1–2 millimeters), dirty brown, whitish in the center, surrounded by a faint yellowish discoloration. Perithecia innate, pale, 80–100μ, with a broad opening above. Sporules oblong cylindrical, 12–16 by 2½–3μ, 2–nucleate becoming 1-septate.

ASCOCHYTA CORNICOLA, Sacc. This seems to be quite variable in the size of the sporules. Saccardo says 7–10 by 3½–4μ. Specimens on leaves of *Cornus sericea* sent from Wisconsin by Dr. J. J. Davis have sporules 7–11 by 5–6μ. Specimens from Ohio sent by Professor Morgan have sporules 10–15 by 3½–4μ. *Phyllosticta cornicola* does not differ in any respect, except that the sporules are not septate, and is probably a less perfectly developed state of *Ascochyta cornicola*.

ASTEROMA RIBICOLUM, *n. s.* On living leaves of *Ribes floribundum*, Helena, Mont., August, 1888; Rev. F. D. Kelsey, No. 210. Epiphyllous. Fibrils branching and radiating from a central point, forming

dark-colored orbicular spots 1 centimeter or more in diameter. The lower surface of the leaf opposite is also of a darker color. The fibrils are closely appressed, and except towards their vanishing extremities are thickly covered with the minute black sterile perithecia.

CONIOTHYRIUM CEPHALANTHI, *n. s.* On living leaves of *Cephalanthus*, Bayou Chene, La., October, 1888; Langlois, 1532. Spots large, suborbicular, or irregular; grayish-brown above, rusty brown below; often subconfluent over a large part of the leaf, all more or less distinctly concentrically zoned. Perithecia hypophyllous, minute, abundant, erumpent, black. Sporules brown, continuous, globose, 4–5μ in diameter, or ovate, 4–5 by 3–3½μ.

SPHÆROPSIS SMILACIS, *n. s.* On dead stems of *Smilax hispida*, Lincoln, Nebr., November, 1888. H. J. Webber, 34. Perithecia scattered, buried in the substance of the bark, bursting the cuticle, but only partially erumpent. Sporules oblong, brown, obtuse, 15–20 by 6–8μ.

SPHÆROPSIS CLADONIÆ, *n. s.* On apothecia of *Cladonia cariosa*, Emma, Mo., March, 1889. Rev. C. H. Demetrio. Perithecia minute, about $\frac{1}{6}$ millimeter in diameter, and a little more than that in height, obconic-cylindrical, subtruncate above. Sporules globose, or obovate-globose, yellowish-brown, about 3μ in diameter, on stout basidia about 6 by 2μ. Differs from *S. parasitans*, B. & Rav., in its differently shaped smaller perithecia and sporules.

HENDERSONIA HETEROPHRAGMIA, *n. s.* On dead twigs of *Sarcobatus vermiculatus*. Near Great Falls, Mont., July, 1889. F. W. Anderson, 541. Perithecia erumpent, superficial, subseriate, globose, collapsing, $\frac{3}{4}$ millimeter in diameter. Ostiolum papilliform. Sporules elliptical or oblong elliptical, brown, 1–3-septate 12–16 by 5–7μ.

HENDERSONIA CONCENTRICA, *n. s.* On living leaves of *Rhododendron catawbiense*, Roan Mountain, North Carolina, July, 1889. Prof. F. L. Scribner. Spots exactly as in *Pestalozzia concentrica*, B. & C., marginal, 1–2 centimeter in diameter, variegated with alternate lighter and darker zones, margin definite, but not raised. Sporules fusoid-oblong, pale-brown, 3-septate, 12–15 by 3μ, on slender basidia 20–30μ. long. Acervuli mostly erumpent above, black. On *Rhododendron maximum* from the same locality, the fungus occurred on large dead areas of the leaf, and the concentric zones were scarcely discernible.

HENDERSONIA DAVISII, *n. s.* On partly dead leaves of *Carya alba*, Racine, Wis., August, 1888. Dr. J. J. Davis, 10. Spots large, occupying the entire upper half of the leaf, dark brown. Perithecia mostly epiphyllous, gregarious, black, erumpent $\frac{1}{8}$ to $\frac{1}{6}$ millimeter in diameter soon more or less buried by the exuding obovate-oblong, pale, olivaceous-black, 3-septate, 10–12 by 3–3½μ, sporules.

SEPTORIA LATHYRI, *n. s.* On dead leaves of *Lathyrus latifolious* (cult.), "Everlasting Pea," Newfield, N. J., March, 1889. Perithecia amphigenous, gregarious, prominent, mostly in groups, 2–4 millimeters

across; the leaf in these parts being slightly blackened. Sporules spiculiform, attenuated to a point at one end and subtruncate at the other, faintly nucleolate, 20–30 by $1\frac{1}{4}\mu$, mostly less than 25μ long. Differs from any of the four species on *Lathyrus* in the Sylloge in its shorter, spiculose sporules. *Septoria viciæ*, West, also has longer and thicker sporules. The general appearance is that of an erumpent *Sphærella*. Perhaps the spermogonia of *Sphærella lathyrina*, B. & C.

SEPTORIA INTERMEDIA, *n. s.* On *Solidago* (*juncea*?), Racine, Wis., June, 1888 (Davis No. 25). Spots small (1 millimeter), scattered, subconfluent dull-white, with a dark purple shaded border. Sporules nearly straight, hyaline, nucleolate 15–25 by 1–$1\frac{1}{2}\mu$. Has the general appearance of *Septoria atropurpurea*, Pk., but is distinguished by its much shorter spores as well as different host.

SEPTORIA PHYSOSTEGIÆ, *n. s.* On leaves of *Physostegia Virginiana*, Racine, Wis., September, 1888. Dr. J. J. Davis, 4. Spots amphigenous, small (1 millimeter), dirty white, with a shaded purplish border. Sometimes several of the small white spots are included in a larger brown spot. Sporules filiform, nearly straight, 20–27 by 1–$1\frac{1}{4}\mu$. *S. brunellæ*, Ell. & Holw. is on larger rusty brown spots and has longer sporules.

SEPTORIA ASTERICOLA, *n. s.* On *Aster cordifolius*, Magnolia, Mass. Miss Clarke; Delaware, Commons, 723 and 724; Wisconsin, Davis. Spots amphigenous, dark brown, subindefinitely limited, bounded by a broad yellow border, the brown central part 3–4 millimeters across. Perithecia innate, finally partially erumpent above, numerous, scattered, small (75μ), scarcely visible in the earlier stages of growth, light brown. Sporules slender, nearly straight, nucleate, 30–45 by 1–$1\frac{1}{4}\mu$. Differs from *S. atropurpurea*, Pk. in its yellow bordered spots and shorter, narrower sporules.

SEPTORIA PRENANTHIS, *n. s.* On leaves of *Prenanthes*, Racine, Wis., August, 1888, Dr. J. J. Davis, 20. Spots scattered, suborbicular, dull white, with a purple border 2–3 millimeters in diameter, thin. Perithecia amphigenous, scattered on the spots, suberumpent, yellowish. Sporules filiform, slightly curved, continuous, 15–22 by 1–$1\frac{1}{4}\mu$.

SEPTORIA ASCLEPIADICOLA. Jour. Mycol., IV, p. 44. The sporules are mostly only $1\frac{1}{2}\mu$ thick instead of 2–$2\frac{1}{2}\mu$. The same thing has been sent from Missouri on *Asclepias rubra*, Demetrio, 215.

SEPTORIA COMMONSII, *n. s.* On leaves of *Cnicus altissimum*, Faulkland, Del., August, 1885. A. Commons, 137. Spots dark brown with a whitish center, round, 2–4 millimeters diameter, obscured below by the tomentum of the leaf. Perithecia epiphyllous, minute, clustered, black, subprominent. Sporules subspiculose, slightly curved, continuous, nucleolate, 25–40 by 1–$1\frac{1}{4}\mu$. *S. cirsii*, Niessl., is said to have sporules 40–80 by $1\frac{1}{2}$–2μ and 8–12-septate. The specimens labeled *S. cirsii*, Niessl., in De Thümen's Austrian Fungi, 690, which are sterile, have the spots concentrically marked and have no white center.

SEPTORIA DEARNESSII, *n. s.* On *Archangelica atropurpurea*, London, Canada, August, 1889. Mr. J. Dearness, 552. Spots amphigenous, dark brown, irregular, angular, 1–5 millimeters in diameter. Perithecia innate, minute, slightly prominent, very obscure. Sporules issuing in white cirrhi, 15–22 by $1\frac{1}{2}\mu$, without nuclei or septa, nearly straight. Approaches *Cylindrosporium* on account of the imperfectly developed perithecia.

SEPTORIA DIVARICATA, *n. s.* On living leaves of *Phlox divaricata*, Lyndonville, N. Y., May, 1889. Dr. C. E. Fairman, 44. This is the *Septoria phlogis*, S. & S.? in Journ. Mycol., III, p. 85. The Lyndonville specimens agree exactly with the Iowa specimens so that there is reason to think this is not an immature state of *S. phlogis*, S. & S., but a different thing. In fact it differs throughout from the description of that species. The spots are not white, only whitish, and the sporules instead of being 40–60 by $1–2\mu$ and 1–3-septate are 15–35 by 1μ, mostly $20–25\mu$ long, nearly straight instead of flexuous, and very faintly nucleolate but not septate.

SEPTORIA FAIRMANI, *n. s.* On living leaves of Hollyhock (*Althæa rosea*), Lyndonville, N. Y., June, 1889. Dr. C. E. Fairman, 77. Spots amphigenous, scattered, subangular, 3–4 millimeters in diameter, dark brown and limited in part by the veinlets, border narrow and dark. Perithecia epiphyllous, rather numerous, scattered quite evenly over the spots, black, $100–112\mu$, subprominent. Sporules filiform, slightly curved, nucleate, 30–45 by $1\frac{1}{2}–2\mu$, hyaline. Whether *S. althææ*, Thüm., is different from this it is impossible to tell, as the specimen in his Austrian Fungi, 955, is a *Cercospora*. He says of this (F. Aust., 955) "perithecia arranged in a circle on dry pale brown spots," which applies very well to his specimen. Apparently De Thümen mistook the tufts of *Cercospora* for perithecia. In Dr. Fairman's specimen the spots are dark brown. *S. lachastreana*, Sacc. & Let. has the sporules 3-septate, and the perithecia are smaller and on minute whitened spots. On the same leaves is a *Phyllosticta* with oblong 3–4 by $1\frac{1}{2}–2\mu$ sporules, on white deciduous spots of about the same size as those producing the *Septoria*. The *Phyllosticta* agrees with *P. althæina*, Sacc., only the sporules are smaller.

SEPTORIA CRYPTOTÆNIÆ, Ell. & Rau.? J. M., III, p. 50. Specimens collected in Delaware by Mr. Commons (910) enable us to add the following notes: Spots white, becoming brown, angular, limited by the veinlets. Perithecia epiphyllous, erumpent, black, depressed-globose, $100–120\mu$, scarcely visible below. Sporules filiform, yellowish, attenuated towards each end, faintly nucleolate, slightly curved 20–30 by $1\frac{1}{4}–1\frac{1}{2}\mu$. The leaf turns yellow around the spots. Perithecia not abundant. This is closely allied to *S. ægopodina*, Sacc., which, however, has smaller perithecia. It is certainly very different from the specimen labeled *Septoria ægopodina*, Sacc. in Fungi Gallici, 1317. From *S. saniculæ*, E. & E. (J. M., IV, 44) it differs in its larger spots, perithecia, and sporules.

SEPTORIA CONVOLVULI, Desm. Prof. Hitchcock sends this from Iowa on *Calystegia sepium*. It is distinguished from *S. calystegiæ*, Desm. and *S. flagellaris*, E. & E. by its more numerous perithecia and larger spots, and from the latter also by its shorter (20–35μ) sporules.

SPHÆRONEMELLA CARNEA, *n. s.* On ash bark, Lake Skaneateles, New York, July, 1872. Rev. J. L. Zabriskie, 119. Perithecia gregarious, erumpent, flesh-colored, subulate, 2 millimeters long, swollen at the base, which contains the sporigenous nucleus. Sporules oblong, hyaline, continuous, about 15 by 4μ, rounded at the ends.

SPHÆRONEMELLA ROSÆ, *n. s.* On dead twigs and old calyx tubes of *Rosa lucida*, Newfield, N. J., June, 1889. Perithecia erumpent, membranaceous, ovate, yellowish, becoming black, about $\frac{1}{5}$ millimeter in diameter; narrowed above into a short, cylindrical, membranaceous, pale ostiolum, crowned with spherical yellow globule of exuded, narrow, elliptical, hyaline, continuous, $4\frac{1}{2}$–$5\frac{1}{2}$ by $2\frac{1}{2}$–3μ sporules. The perithecia are loosely bordered by the ruptured epidermis and white inside from the mass of sporules. This approaches *Cytispora*, but the perithecia are simple.

ASTERINULA nov. gen. of **SPHÆROPSIDEÆ** Fam. **LEPTOSTROMACEÆ.**

Perithecia dimidiate, scutelliform, submembranaceous, radiate-cellulose; sporules ovoid or oblong, 1-septate, hyaline. Differs from *Leptothyrium* in its uniseptate sporules, from *Asterina* in the absence of asci, and from *Ascochyta* in its superficial perithecia.

ASTERINULA LANGLOISII, *n. s.* On living leaves of *Magnolia grandiflora*, Louisiana, January, 1889. Rev. A. B. Langlois, 1656. Hypophyllous. Perithecia scattered or gregarious, not on any definite spots, dimidiate, superficial, radiate, cellulose, pierced above, 100–112μ in diameter mostly with a short fringe of brown mycelium around the margin. Sporules oblong or obovate-oblong 2-nucleate, becoming 1-septate, hyaline, 18–22 by 7–8μ, ends rounded and obtuse. Probably the spermogonial stage of some *Asterina*.

DIPLODINA RAMULORUM, *n. s.* On bleached stems of *Smilax* and *Lycium*, Newfield, N. J. Perithecia subcuticular, black, minute, gregarious. Sporules oblong, elliptical, smoky hyaline, 1-septate, 5–8 by 2–3μ.

DISCULA XANTHOXYLI, *n. s.* On dead stems of *Xanthoxylum*, St. Martinsville, La., January, 1889. Rev. A. B. Langlois, 1600. Perithecia gregarious, on bleached spots 2–3 centimeters long by $\frac{1}{2}$ centimeter broad, subdiscoid, about 150μ in diameter, of rather coarse cellular texture, with a small circular opening above. Immediately around this opening the perithecium is more compact and nearly opaque, but around this dark center it is thinner and translucent. Sporules abundant, oblong-cylindrical, hyaline, continuous, 12–20 by 3–$3\frac{1}{2}\mu$, arising directly from the cells of the proligerous layer, which are some-

times elongated and even imperfectly branched so as to form rudimentary basidia.

DISCULA RUNCINATA, *n. s.* On dead stems of *Stephanomeria runcinata*, Helena, Mont., January, 1889; Rev. F. D. Kelsey, 133. Gregarious or scattered, covered at first by the epidermis and then convex and closed, soon erumpent, and the upper part of the perithecia disappearing, leaving a broad opening above; of coarse cellular texture, 150–200 μ in diameter. Sporules hyaline, continuous, oblong, curved, generally more strongly so at one end, 18–23 by 3½–4 μ. The sporules and the perithecia also are those of a *Vermicularia*, only the hairs or bristles are wanting.

DISCELLA PILOSULA, *n. s.* On a decorticated maple, Lyndonville, N. Y., April, 1889, Dr. C. E. Fairman. Perithecia gregarious, ovate ⅓ to ½ millimeter in diameter, erumpent, superficial, black, rough, and sparingly clothed with short, spreading, pale, glandular hairs intermixed with a few black bristle-like hairs, at first closed, then with a broad opening above, the margin sublacerate dentate or subfimbriate. Texture of the perithecia subfibrous. Sporules cylindrical, curved, 3-6-nucleate and either continuous or faintly 1-septate, brownish-hyaline, 10–16 by 2–2½ μ, the ends mostly abruptly mucronate-pointed and incurved. Basidia slender, simple, or sometimes branched, 25–30 μ long. This would come better under *Amerosporium* but for the 1-septate sporules. The septum was only observed in the larger and more mature sporules and was then very faint, but there is no doubt of its presence, nor is it unlikely that after the specimens have lain in the herbarium a few years they may become three or more septate.

SPORONEMA PALLIDUM, *n. s.* On bleached spots on bare decaying wood of maple, Ridgeway, N. Y., May, 1889, Dr. C. E. Fairman, 58. Perithecia gregarious, erumpent, cespitose, ½ millimeter in diameter, multiradiate-cleft above or after the laciniæ have disappeared, irregularly lacerate-cleft; at first closed. Sporules concatenate, 8–10 by 2 μ, sub-cylindrical, hyaline, formed by constriction of the sporogenous filaments.

GLŒOSPORIUM REVOLUTUM, *n. s.* On living leaves of *Robinia pseudácacia*, Newfield, N. J., August, 1889. Mostly on leaves of the terminal shoots. The margin of the leaf becomes yellowish green and revolute, then brown and dead. The oblong 12–15 by 3–4½ μ spores begin to ooze out from the buried acervuli as the affected part begins to turn brown, soon becoming confluent and forming a flesh-colored coating on the surface of the leaf. In the early stage of growth the fungus has the aspect of a *Taphrina*.

GLŒOSPORIUM CANADENSE, *n. s.* On living leaves of white oak, London, Canada, July, 1889; J. Dearness, 193. Spots amphigenous, irregular, subrotund, about ½ centimeter in diameter, pale rusty brown in the center, with a broad dirty brown border and tolerably definite margin above, more indefinite below. Acervuli scattered, be-

coming dark, 180–200μ in diameter. Mostly erumpent above. Spores ovate-oblong, hyaline 10–14 by 3½–4½μ. Possibly not distinct from *G. umbrinellum*, B. & Br., but that is said to have the spots "minute."

GLŒOSPORIUM HYSTERIOIDES, *n. s.* On orange leaves, Florida, 1886; Dr. George Martin. Spots large, mostly marginal, yellowish at first, then cinereous, and finally dirty white, border yellow, broad, and slightly elevated. Acervuli erumpent, black hysteriiform. Spores oblong, 12–15 by 3½–5μ, not curved, basidia shorter than the spores. Spots 1–2 centimeters across, often extending along the margin of the leaf. Differs from *G. sphærelloides*, Sacc., in its short basidia and from *G. hesperidearum* in its definite spots.

GLŒOSPORIUM RAMOSUM, *n. s.* On leaves and stems of *Polygala polygama*, Newfield, N. J., June, 1889. Parts of the leaf at first turn dark purple and on these discolored places appear small, circular yellowish-white spots about 1 millimeter in diameter. In these spots are seated the innate acervuli, generally only one at first in the center of the spot, finally 2–4, slightly prominent and black above, appearing like the erumpent apex of a small perithecium, but the oblong-cylindrical, slightly curved, obtusely pointed, granular, continuous, 12–22 by 3–3½μ spores, on thick branching basidia, about as long as the spores themselves, are discharged below. This differs from the other species of *Glœosporium* in its branched basidia which much resemble the spores themselves. The fungus is very destructive to the plants, all the leaves soon turning pale-yellowish and falling off.

GLŒOSPORIUM (MARSONIA) BRUNNEUM, *n. s.* On leaves of *Populus candicans*, Newfield, N. J., August, 1889. Leaf mottled above with small black spots which soon become confluent in large areas, especially around the margin, the entire lower surface of the leaf soon assuming a uniform bronze-brown color. Acervuli 1–3 in each of the minute black spots, pale, erumpent on both sides of the leaf, finally nearly black. Conidia clavate obpiriform, hyaline, 1-septate below the middle, 14–16 by 5–7μ. On account of the smaller conidia and different habit this seems sufficiently distinct from *G. populi* and *G. castagnei*. There are no well defined spots, only the small black specks soon confluent and blackening finally the greater part of the leaf.

GLŒOSPORIUM (MARSONIA) GRAMINICOLUM, *n. s.* On living leaves of grasses, London, Canada, August, 1889. J. Dearness, 341. Spots amphigenous, black, subindefinite, 2–3 millimeters, becoming white in the center from the erumpent spores. Acervuli minute, buried, cirrhi white, minute. Spores cylindrical, 1-septate, 15–22 by 3–4μ hyaline. The leaf is slightly thickened at the spots.

PHLEOSPORA ACERIS, (Lib.). On leaves of *Acer dasycarpum*, Manhattan, Kans., July, 1887. W. T. Swingle. Dr. Winter has issued this in his Exsicc. (3480) under this name (see also N. A. F. Cent., XXIII). *Glœosporium acerinum*, Pass. in De Thümen's Mycotheca (93)

differs only in its rather shorter spores, which are also more distinctly thickened at one end. In both they are 3-septate.

GLŒOSPORIUM (SEPTOGLŒUM) AMPELOPSIDIS, *n. s.* On fading leaves of *Ampelopsis quinquefolia*, Racine, Wis., September, 1888, Dr. J. J. Davis, 69. Spots amphigenous, angular, limited by the veinlets of the leaf, 2–3 millimeters in diameter, greenish. Acervuli erumpent on both sides of the leaf, prominent. Spores clavate-cylindrical, 5–9-septate, 30–35 by 4–4½ μ.

GLŒOSPORIUM LAGENARIUM, Pass. var. MUSARUM, E. & E. On banana rind, Lincoln, Nebr., Roscoe Pound, 23, does not differ essentially from the forms on various species of *Cucurbitaceæ*. A foliicolous form of this species has proved very destructive around Newfield, N. J., this year on water-melon and musk-melon vines.

CYLINDROSPORIUM? OCULATUM, *n. s.* On leaves of *Populus monilifera*, Put-in-Bay, Ohio, August, 1888, Dr. J. J. Davis, 14. Spots amphigenous, round, 3–5 millimeters in diameter, grayish white, with a darker margin and a narrow raised border. Acervuli innate, amphigenous, yellowish (finally blackish), rather large ($\frac{1}{5}$ millimeter). Spores clavate-cylindrical, curved, 30–50 by 3μ nucleate (becoming 3 or more septate).

CYLINDROSPORIUM CLEMATIDIS, E. & E. J. M. III, p. 22. Mr. Galloway sends some leaves of *Clematis Jackmanii* collected at Geneva, N. Y., June 20, 1889, in which the tubercular masses of exuded spores are *black*, but the spores themselves are hyaline as in the original specimen on *C. Virginiana*. In the Geneva specimen the spots are less distinct and definite, and the acervuli are not confined to the spots, thus differing considerably from the original description. It may, however, be doubted whether the specimens on *C. Jackmanii* are specifically distinct, and we have for the present at least placed them as a variety, *C. clematidis*, E. & E., var. *Jackmanii*.

CYLINDROSPORIUM VIRIDIS, *n. s.* On living leaves of *Fraxinus viridis*, St. Martinsville, La., May, 1889. Langlois, 1712. Spots (on the upper side of the leaf) numerous, dark purple, suborbicular, 3–4 millimeters in diameter, with a subindefinite margin and a small (1 millimeter or less) rusty-brown center. On the lower surface of the leaf the purple color is entirely wanting, only dirty brown 1–2 millimeter subindefinite spots opposite the center of those on the other side. Acervuli innate, 3–6, in or near the center of the spots, prominent below, but opening above and discharging snow white heaps of cylindrical fusoid, 30–35 by 2½ μ, nucleate spores curved nearly to a semicircle. The measurement is from tip to tip as the spores lie curved. Readily distinguished from *C. fraxini*, E. & K., by the purple spots and shorter spores. What appears to be the same, but without fruit, has also been sent from Ohio (Morgan, 405).

CYLINDROSPORIUM SACCHARINUM, *n. s.* On living leaves of *Acer*

saccharinum, Racine, Wis., October, 1888. Dr. J. J. Davis, 59. Spots amphigenous, numerous, scattered, subangular, minute (mostly about 1 millimeter in diameter), greenish black, becoming darker. Acervuli hypophyllous, minute, crowded in the spots, black above, so as to resemble minute perithecia. Spores slender-cylindrical, more or less curved, hyaline, granular, becoming faintly 3-septate, 30–40 by $2\frac{1}{2}$–3μ erumpent in small white heaps which soon spread out into a small membranaceous patch like a minute white *Corticium*. This can not easily be mistaken for *Glœosporium aceris*, Cke. or *G. acerinum*, West.

HAINESIA BOREALIS, *n. s.* On *Galium boreale*, Haniloops, British Columbia, July, 1889. Dr. John Macoun, 156. Acervuli hypophyllous, scattered, suborbicular, erumpent, $\frac{1}{2}$ to $\frac{3}{4}$ millimeter in diameter, subgelatinous, yellowish-hyaline, depressed-hemispherical, with a narrow black linear margin formed from the ruptured epidermis of the leaf. Spores suballantoid, 5–7 by 1μ, faintly 2-nucleate, slightly curved, borne on fasciculate, more or less branched basidia, 20–25 by 1μ.

CRYPTOSPORIUM NUBILOSUM, *n. s.* On dead or partly dead leaves of *Carex* (*Pennsylvanica?*) Newfield, N. J., 1879. Sent also from Montana by Mr. Anderson (344) on an allied species of *Carex*. Acervuli innate, scarcely erumpent, black, 80–110μ in diameter, showing by translucence through the epidermis, gregarious in bands across the leaf or seriate. Sporules lunate-fusoid, 15–20 by $2\frac{1}{2}\mu$, *hyaline*, faintly nucleate.

NÆMASPORA MICROSPERMA, *n. s.* On bark of *Acer saccharinum*, London, Canada, August, 1889. J. Dearness, No. 562. Sporiferous cavities confluent for 1–2 centimeters between the laminæ of the bark, purplish-black, the minute, ovate, or elliptical 2–$2\frac{1}{2}$ by $1\frac{1}{2}$–2μ spores bursting out in copious cherry-red masses and cirrhi through cracks in the bark. Differs from *C. difformis*, Sz., in its smaller spores on basidia, 12–15 by $1\frac{1}{2}\mu$.

PESTALOZZIA AFFINIS, *n. s.* On fallen leaves of "Japan Chestnut," Lafayette, La. Acervuli innate, erumpent, on both sides of the leaf, but more abundant below. Spores acutely elliptical, pale, 15 by 5μ (about 12μ) between the extreme septa, 4-septate, with a single oblique bristle about 7μ long at the apex and borne on a pedicel shorter than the spore. The spores ooze out in small black heaps, which are as usual often subconfluent-diffused. This differs from *P. pallida*, E. & M., in its broader spores and in lacking the *prominent septa* of that species.

PESTALOZZIA FLAGELLIFERA, *n. s.* On branches of *Comptonia asplenifolia*, killed by fire a few weeks ago, Newfield, N. J, June 10, 1889. Pustules numerous, subcuticular, raising the epidermis into little tuberculiform pustules which become slightly ruptured above and have a dark gray nucleus. Spores abundant, oblong, slightly curved 1-septate, yellowish-hyaline, 9–12 by 3μ, on stout basidia, about as long as the spores with a single long (25–35μ) undulate, hyaline bristle ris-

ing from one side of the apex. The spores are mostly a little narrower below and more acute.

PESTALOZZIA AQUATICA, *n. s.* On living leaves of *Peltandra Virginica*, Newfield, N. J., August, 1889. Spots amphigenous, chestnut brown ½ to 1 centimeter in diameter, concentrically wrinkled, border narrow, darker, acervuli epiphyllous, erumpent, ¼ to ⅓ millimeter in diameter, black, convex, then concave. Spores obovate, 18–20 by 6–7 μ, 4-septate, end cells hyaline, next to the lower cell subhyaline, two next above dark. Crest of three stout (15–20 by 1 μ) hyaline spreading bristles. What appears to be the same is found also on leaves of *Sarracenia purpurea*.

PESTALOZZIA NERVALIS, *n. s.* On veinlets of living white-oak leaf from which the parenchyma had been eaten away by some larva, Racine, Wis., September, 1888. Dr. J. J. Davis, 3. Acervuli subhysteriiform. Conidia narrow, elliptical or broad, oblong-fusoid, 4-septate, terminal cells hyaline, colored part (3 inner cells) about 14 by 6 μ, lower hyaline cell 8–9 μ, long, oblique bristle at the apex 8–9 μ long.

PESTALOZZIA MAURA, E. & E. J. M. IV, p. 123. Mr. Langlois finds this at St. Martinsville, La., on dead leaves of *Persea Carolinensis* and on leaves of *Quercus virens* and *Q. palustris*, differing from the Florida specimens only in the absence of any spots, the innate erumpent acervuli being scattered irregularly over the leaf and mostly erumpent below. This species is well characterized by its obconic conidia, having the two cells next below the upper hyaline cell almost black.

BLACK SPOT OF ASPARAGUS BERRIES.

By CHARLES E. FAIRMAN.

These berries are of some slight agricultural importance. Thus we read in the report of the U. S. Agricultural Department for 1885, p. 613, "To save seed the stalks should be cut when the former are scarlet and ripe, to be stripped by hand or thrashed off on a cloth or floor, then pounded in a wooden mortar with a wooden pestle to break the outer shells. The seeds are then frequently washed to float away the chaff, dried in the sun and air and stored."

Asparagus berries are liable to a disease which may, for brevity's sake, be called black spot.

This is due (*a*) to the growth of fungi in the interior of the berry, (*b*) to growth of fungi on the exterior of the berry.

(*a*) Some asparagus berries which had been gathered in September, 1886, were found, a month or two later, to show black spots in the interior. In the blackened substance of the berry, mycelial threads were frequently found, but fruiting specimens were rare. The black spots were thought to be due to chemical changes in the berry produced by fungi. The fungus which causes this is probably *Penicillium glaucum*. The determination was made according to the figure of this fungus given by Beale.*

The contents of the berry would seem to furnish a favorable medium for the growth of fungi. Reinsch, in 1870 (according to the National Dispensatory 1879, p. 249), found in the berries considerable grape sugar.

(*b*) External spotting of the berry is due to the growth of fungi on the surface. This was noticed in berries which remained on the stems some time after ripening. The stems are covered at times with a black incrustation which may extend to the berry and involve more or less of its surface. The most common cause of this is the growth of *Cladosporium*.

This brief note will have fully served its purpose if it calls attention to these growths and thus better fruited specimens (than I have as yet found) are secured. As is well known, the most common fungi on decaying vegetable matter are *Macrosporium* and *Cladosporium*. J. B. Ellis (in letter of January 28, 1887), has said:

> It is not improbable that with the proper degree of heat and moisture one or the other of these would make its appearance on the berries in the form of a velutinous or fine hair-like growth of fertile threads bearing the spores or conidia peculiar to one or the other of these genera.

At present nothing farther can with certainty be said.

AN EXPERIMENT IN PREVENTING THE INJURIES OF POTATO-ROT (*Phytophthora infestans.*)†

By CLARENCE M. WEED.

(1) The experiment reported by the author was undertaken to determine what effect the application of a solution of sulphate of copper and lime (known as the Bordeaux mixture) to the foliage of potatoes would have in preventing the injuries of the potato-rot, and was conducted on the grounds of the Ohio Agricultural Experiment Station.

(2) Fifteen feet at the end of each of twenty rows of potatoes were

* Microscope in Medicine, fourth edition, Fig. 7, Plate XXV.

† Summary of a paper read before the Society for the Promotion of Agricultural Science, August 27, 1889.

sprayed with the Bordeaux mixture four times, viz, May 28, June 6, June 29, and July 16. Four varieties were included in the experiment, viz, Early Ohio, Early Oxford, Puritan, and Lee's Favorite.

(3) The season proved favorable for the development of the blight, which appeared in the experimental field about the middle of June, and did serious damage for the next six weeks.

(4) The sprayed vines showed much less injury than their unsprayed companions, remaining green after the others were dead.

(5) The crop was harvested August 22, and the product of 12½ feet of the sprayed part of each row was compared with the product of an equal distance of the unsprayed portion of the same row. The results have been summarized as follows:

(*a*) From the treated portions of four rows of the Early Ohio variety, 536 potatoes, weighing 67 pounds 4 ounces, were obtained, of which 231 were of marketable size and weighed 48 pounds 6 ounces; while from the untreated portions of the same rows 496 potatoes weighing 50 pounds were obtained, 200 of which were marketable, and weighed 34 pounds 4 ounces. There was thus an increase in favor of the treated hills of 17 pounds 4 ounces total product, and 14 pounds 2 ounces marketable product.

(*b*) The treated portions of five rows of Early Oxford potatoes yielded a total of 622 tubers, weighing 87 pounds 1 ounce, of which 321, weighing 70 pounds 4 ounces, were marketable, while the untreated hills of the same rows yielded a total of 707 tubers, weighing 77 pounds 4 ounces, of which 267, weighing 53 pounds 2 ounces, were marketable. There was thus an increase in favor of treated hills of 9 pounds 13 ounces total product, 17 pounds 2 ounces marketable product.

(*c*) The treated portions of six rows of the Puritan variety yielded a total of 727 potatoes, weighing 93 pounds 6 ounces, 327 of which, weighing 70 pounds 4 ounces, were marketable, while the untreated portions of the same rows yielded 810 potatoes, weighing 83 pounds 12 ounces, of which 266, weighing 53 pounds 15 ounces, were of marketable size. There was thus an increase in favor of the treated hills of 9 pounds 10 ounces total, and 16 pounds 5 ounces marketable product.

(*d*) From the sprayed portions of five rows of Lee's Favorite potatoes, 584 tubers, weighing 72 pounds 12 ounces, were obtained, of which 249, weighing 55 pounds 4 ounces, were marketable; while the unsprayed portions of the same rows yielded 658 tubers, weighing 63 pounds 4 ounces, 175 of which were of marketable size, and weighed 38 pounds 12 ounces. Consequently, there was a difference in favor of the sprayed hills of 9 pounds 8 ounces total weight, and 16 pounds 8 ounces marketable weight.

(6) By combining the results given in paragraphs *a*, *b*, *c*, and *d*, we find that the treated portions of the twenty rows yielded a grand total of 2,471 potatoes, weighing 320 pounds 7 ounces, and that 1,128 of these were of marketable size, and weighed 244 pounds 2 ounces; while the

untreated portions of the same rows yielded a grand total of 2,771 potatoes, weighing 274 pounds 4 ounces, of which 948 were of marketable size and weighed 180 pounds 1 ounce. There was consequently a grand total increase in favor of the treated hills of 46 pounds 3 ounces total product, and 64 pounds 1 ounce marketable product.

(7) This 64 pounds 1 ounce increase in marketable product was obtained from 250 feet of row (20 times 12½). This represents an increase of 4.1 ounces to the foot. As there are 14,560 feet of row in an acre of potatoes as ordinarily planted, an increase of 4.1 ounces to the foot amounts to 59,696 ounces, or 3,731 pounds to the acre. Reducing this to bushels by dividing by 60 (the number of pounds to the bushel) we get an increase from the treatment of 62.2 bushels to the acre.

(8) There was in nearly every case a marked difference in the amount of scab on the treated and untreated tubers, the former being much more free from the disease.

CONCLUSIONS.

So far as a single experiment can be relied upon, the results here reported seem to indicate the correctness of the following provisional conclusions:

(1) That a large proportion of the injury done by the potato rot can be prevented by spraying the vines with the Bordeaux mixture.

(2) That this treatment apparently diminishes the amount of scab affecting the tubers.

(3) That by adding London purple to the mixture, the same treatment may be made effective in preventing the injuries of both the rot and Colorado Potato Beetle.

NEW EXSICCATI.

By D. G. Fairchild.

I. PARASITIC FUNGI OF CULTIVATED PLANTS.

The second fasicle of Messrs. Briosi & Cavara's Parasitic Fungi of Cultivated Plants* has been received. The fascicle contains many interesting things, the following of which are of special importance to this country:

Phytophthora infestans, (Mont.) DBy., on *Solanum lycopersicum.*
Plasmopara viticola, B. & C., on *Vitis vinifera.*
Uromyces trifolii, Wint., on *Trifolium pratense.*
Puccinia graminis, Pers., (I), on *Berberis vulgaris.*
Cercospora rosæcola, Pass., on *Rosa, (cult.).*
Coniothyrium diplodiella, (Speg.) Sacc., on *Vitis vinifera.*
Colletotrichium lindemuthianum, (S. & M.) B. & Cav., on *Phaseolus vulgaris.*

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* Funghi Parassiti Delle Piante Coltivate od Utili.

It will be seen that the following well-known diseases are represented: The downy mildew of the tomato and grape, the rust of clover and grass, leaf blight of the rose, white-rot of the grape, and anthracnose of the bean. The latter disease, as well as some of the others, have been quite fully illustrated and described in the reports of this Section. It is to be regretted that the descriptive part of this work is Italian; notwithstanding this, however, it seems to us that it would prove a valuable acquisition to the collection of every experiment station.

II. KELLERMAN & SWINGLE'S KANSAS FUNGI.

The second neatly prepared fascicle of the fungi of Kansas has lately appeared. The list of species and host plants is as follows:

ÆCIDIUM CALLIRRHOËS, E. & K., on *Callirrhoë involucrata.*
ÆCIDIUM GROSSULARIÆ, Schum., *Ribes aureum.*
ÆCIDIUM PENTSTEMONIS, Schw., *Pentstemon grandiflorus.*
ÆCIDIUM PUSTULATUM, Curt., *Comandra umbellata.*
ÆCIDIUM TUBERCULATUM, E. & K., *Callirrhoë involucrata.*
CÆOMA NITENS, Schw., *Rubus villosus.*
CERCOSPORA ALTHÆINA, Sacc., *Althæa rosea.*
CERCOSPORA DIANTHERÆ, E. & K., *Dianthera Americana.*
CERCOSPORA JUGLANDIS, Kell. & Sw., *Juglans nigra.*
CERCOSPORA POLYTÆNIÆ, E. & K., *Polytænia Nuttallii.*
CERCOSPORA TUBEROSA, E. & K., *Apios tuberosa.*
DENDRYPHIUM SUBSESSILE, E. & E., *Smilax hispida.*
ENTYLOMA PHYSALIDIS, (Klachbr. & Cke.) Wint., (*a*) *Physalis lanceolata;* (*b*) *Physalis pubescens.*
FUSICLADIUM EFFUSUM, Wint., *Carya amara.*
GLŒOSPORIUM NERVISEQUUM, (Fckl.) Sacc., *Platanus occidentalis.*
PERONOSPORA ANDROSACES, Niessl., *Androsace occidentalis.*
PHYLLOSTICTA IPOMŒÆ, E. & K., *Ipomœa pandurata.*
PUCCINIA NIGRESCENS, Peck., (*a*) *Salvia lanceolata:* (*b*) *Salvia azurea,* var. *grandiflora.*
PUCCINIA SCHEDONNARDI, Kell. & Sw., *Schedonnardus Texanus.*
PUCCINIA SILPHII, Schw., *Silphium integrifolium.*
RAMULARIA URTICÆ, Ces., *Urtica gracilis.*
SEPTORIA TENELLA, Cke. & Ell., *Festuca tenella.*
UROMYCES GRAMINICOLA, Burrill, *Panicum virgatum.*
UROMYCES HYALINUS, Peck., *Sophora sericea.*
UROMYCES POLYGONI, (Pers.) Fckl., (*a*) *Polygonum aviculare;* (*b*) *Polygonum ramosissimum*; leaves (*c*) *Polygonum ramosissimum,* stems.

III. SYDOW'S UREDINEÆ.

The following is a condensed list of the contents of Fascicle III of Sydow's exsiccati, designed to contain only species of the rust fungi, or order *Uredineæ.* Fascicles I and II were issued some time ago; each fascicle contains fifty specimens. The specimens are large and well mounted, and, with the exception of the written labels, the work is altogether a very satisfactory one:

UROMYCES TRIFOLII, (Hedw.) Wint., on *Trifolium hybridum.*
UROMYCES LIMONII, (DC.) Wint., *Armeria vulgaris.*
UROMYCES POLYGONI, (Pers.) Wint., *Polygonum aviculare.*
UROMYCES GERANII, (DC.) Wint., *Geranium molle.*
UROMYCES STRIATUS, Schrœt., *Trifolium arvense.*
UROMYCES ANTHYLLIDIS, (Grev.) Schrœt, *Anthyllis vulneraria.*
UROMYCES ERYTHRONII, (DC.) Wint., *Fritillaria Meleagris.*
UROMYCES ERYTHRONII, (DC.) Wint., ÆCIDIUM, *Erythronium dens canis.*
UROMYCES FICARIÆ, (Schum.) Lév., *Ficaria verna.*
UROMYCES SCILLARUM, (Grev.) Wint., *Muscaria racemosum.*
UROMYCES SCILLARUM, (Grev.) Wint., *Scilla maritima.*
PUCCINIA GALII, (Pers.) Wint., *Galium aparine.*
PUCCINIA CALTHÆ, Link, *Caltha palustris.*
PUCCINIA CIRSII-LANCEOLATI, Schrœt., *Cirsium lanceolatum.*
PUCCINIA LAMPSANÆ, (Schultz) Fckl., *Lampsana communis.*
PUCCINIA CREPIDIS, Schrœt., *Crepis actorum.*
PUCCINIA VIOLÆ, (Schum.) Wint., *Viola hirta.*
PUCCINIA PIMPINELLÆ, (Str.) Wint., *Pimpinella magna.*
PUCCINIA GRAMINIS, Pers., *Triticum repens.*
PUCCINIA CORONATA, Cd., *Glyceria spectabilis.*
PUCCINIA RUBIGO-VERA, (DC.) Wint., *Bromus mollis.*
PUCCINIA RUBIGO-VERA, (DC.) Wint., *Symphitum officinale.*
PUCCINIA POARUM, Niel., *Poa nemoralis.*
PUCCINIA PHALARIDIS, Plowr., *Degraphis arundinacea.*
PUCCINIA SUAVEOLENS, (Pers.) Wint., *Cirsium arvense.*
PUCCINIA HIERACII, (Schum.) Schrœt, *Carlina vulgaris.*
PUCCINIA BULLATA, (Pers.) Wint., *Peucedanum cervaria.*
PUCCINIA FALCARIÆ, (Pers.) Wint., *Falcaria Rivini.*
PUCCINIA FALCARIÆ, (Pers.) Wint., ÆCIDIUM, *Falcaria Rivini.*
PUCCINIA ANEMONES-VIRGINIANÆ, Schw., *Anemone silvatica.*
PUCCINIA TORQUATI, Pass, *Smyrnii olusatrum.*
PHRAGMIDIUM SANGUISORBÆ, (DC.) Schrœt., *Sanguisorba minor.*
PHRAGMIDIUM SUBCORTICIUM, (Schrk.) Wint., *Rosa canina.*
GYMNOSPORANGIUM CLAVARIÆFORME, (Jacq.) Wint., ÆCIDIUM, *Crataegus oxyacantha.*
MELAMPSORA HELIOSCOPIÆ (Pers.) Wint., *Euphorbia esula.*
MELAMPSORA VACCINII, (Alb. & Sch.) Wint., *Vaccinium vitis idæa.*
MELAMPSORA CIRCÆÆ, (Schum.) Wint., *Circæa lutetiana.*
MELAMPSORA PYROLÆ, (Gmel.) Schrœt., *Pyrola uniflora.*
COLEOSPORIUM SENECIONIS, (Pers.) Wint., ÆCIDIUM, *Pinus austriaca.*
COLEOSPORIUM SONCHI-ARVENSIS, (Pers.) Wint., *Sonchus arvensis.*
COLEOSPORIUM CAMPANULÆ, (Pers.) Wint., *Campanula patula.*
CHRYSOMYXA SEDI, (Alb. & Sch.) Wint., *Sedum palustre.*
CÆOMA EMPETRI, (Pers.) Wint., *Empetrum nigrum.*
CÆOMA LARICIS, (Westd.) Wint., *Laris Europæa.*
ÆCIDIUM AQUILEGIÆ, Pers., *Aquilegia vulgaris.*
ÆCIDIUM PEDICULARIS, Sibosch, *Pedicularis palustris.*
ÆCIDIUM CRESSÆ, DC., *Cressa cretica.*
ÆCIDIUM MESPILI, DC., *Mespilus Germanica.*
ÆCIDIUM MESPILI, DC., *Crataegus grandiflora.*
PUCCINIA HIERACII, (Schum.) Schroth. *Taraxacum officinale.*

A METHOD FOR PRESERVING THE SPORES OF HYMENOMYCETES.*

By Dr. C. O. Harz.

In studying and making a collection of the *Hymenomycetes* the preservation of spore preparations on paper is everywhere enjoined.

Formerly I used a very simple method for colored spores. I allowed them to fall upon any convenient white paper, a process which required from one to two hours up to a half or an entire day, according to the object. After the removal of the fungus I allowed the spores to lie a short time in the air in order to become dry, when I spread a solution of Canada balsam in absolute alcohol, on the back side of the paper, taking care that the spore preparation should not be overflowed by a too copious amount of the fluid. In this manner the preservation or fixing of the spores is accomplished simply and quickly.

I met with difficulties in case of colorless spores, because it is always hard to obtain suitable, well-glazed colored paper whose coloring material is not soluble in alcohol.

Herpell attempted to remove the difficulty by the application of ether, mastix, etc., but I was not always successful in obtaining satisfactory preparations of white spores in this way.

I have successfully tested the following method for two years: Dissolve one part Canada balsam in four parts turpentine oil, warming them gently over a water bath or free flame. Spores of all colors, as well as colorless ones, can be quickly fixed upon any convenient white or colored paper with this solution.

For colored spores I take any smooth, wood-free, white writing paper, of different grades; for white, relatively colorless spores, any convenient glazed paper can be used. Blue and black are specially adapted to the purpose, but yellow, red, green, and other colors of glazed papers also furnish beautiful preparations.

The application of the above solution is very simple; it should be spread thinly on the back side of the paper on which the spores are scattered, with a soft brush, and should not be spread on so thickly as to overflow the spores. In from two to four days the preparations are so far dried out that they can be safely kept between papers. They become quite dry (that is, so that the finger will not rub them off) in four to six weeks.

In some cases this method required some minor corrections.

(1) If the spores have been shed in unusual abundance, it is a good plan to repeat the application once after one or two days, or prepare for this special purpose a solution of two parts Canada balsam in five or six parts of turpentine oil.

(2) If the so-called white spores fall very sparingly on the paper, I

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* Translated from *Botanisches Centralblatt*, 1889, page 78, by E. A. Southworth.

use a solution of one part Canada balsam in from six to eight parts of turpentine oil.

It is perfectly self-evident that any other balsam soluble in turpentine oil, *i. e.*, turpentine, or a resin soluble in it, will answer the same purpose. Any other volatile oil can also be substituted for turpentine oil.

A DISEASE OF WHITE FIR.*

By Dr. Hartig.

A disease of the white fir, which caused very great injuries in the Bavarian woods, was discovered by the author, and shows itself in the dying of the bark of younger or older twigs and branches, often for over a hand's length. As a rule, the dying extends over the entire circumference of the twig, and in consequence the parts of the plants situated above this point die in a few years. More rarely the disease is confined to one side of the twig, and does not progress the second year, but an outgrowth occurs at the edge of the dead place. In the dead bark there develop numerous pycnidia, rarely larger than the head of a pin, which rupture the superimposed cork layer. Within the pycnidia arise numerous small, spindle-shaped gonidia, which germinate readily. Unfortunately, an acigerous fruiting form has not been found after several years of observations and culfures. To be sure *Peziza calycina* almost constantly produced a luxuriant formation of Apothecia in the immediate neighborhood, yet the absolute proof of its connection with the pycnidial form was impossible. Until it can be perfectly known the author has given this fungus the name *Phoma abietina, n. sp.*

NOTES.

By B. T. Galloway.

PREVENTION OF SMUT.

In the first number of The Journal† we gave a brief review of a paper published in the *Journal of the Royal Agricultural Society* of England by J. L. Jensen on "The Propagation and Prevention of Smut in Oats and Barley." The interest shown in this paper has prompted us to publish a description of Mr. Jensen's method of treating the grain, and it is hoped that the suggestions made will enable the experiment stations to test the remedy. Mr. Jensen says:

> We have seen that smut can be prevented by dipping the grain in heated water. * * * The grain to be dipped is placed in a shallow cylindrical basket about 12 inches deep, lined with coarse canvas, and provided with a cover made by stretching the canvas over a ring of such a diameter as will pass inside the mouth of the basket.

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* Translated from *Botanisches Centralblatt* No. 3, p. 78, 1889, by E. A. Southworth.

† Page 42.

The canvas should overlap the ring by about an inch all round. An ordinary boiler, such as is found on every farm, is filled with water and heated to the boiling point.

Two vessels of sufficient size are placed near it. These may be designated 1 and 2. Supposing the boiler to contain 35 gallons of boiling water, if 12½ gallons of cold and the same quantity of boiling water be put into each vessel, we shall have 25 gallons of water at 132° F., in both of them. The exact temperature may be readily obtained by adding a little more hot or cold water, as the thermometer shows to be required.

A basket containing three-quarters of a bushel of grain, which must not be more than 8 inches in depth, is now dipped into No. 1 four times; this will take rather more than half a minute, and will reduce the temperature of the water 8 or 9 degrees. It is now to be rapidly dipped five or six times into No. 2, which will take about one minute, and then dip once per minute for three minutes longer, *i. e.*, five minutes altogether in the two vessels This will reduce the temperature of the water in No. 2 from 132° to 129° to 130°. If steeped barley be used the original temperature of the vessels should be 129° to 130°; but with unsteeped grain, for oats, wheat or rye, it does not matter if the original temperature be 133° to 136°.

The seed must now be cooled. This is best done by placing the basket on the top of a third vessel and pouring a couple of buckets of cold water upon the grain in it, taking care that the cold water falls not only upon the center, but round the edges, so that the corn may be uniformly cooled. The basket is now emptied on the floor and the seed spread out in a thin layer, so that it may cool completely. The water used in cooling the grain will have its temperature raised and may be employed in replenishing the boiler. The requisite temperature (132° F.) of vessels Nos. 1 and 2 must be maintained throughout the process by adding from time to time boiling water from the boiler and transferring from them a similar amount back again to the boiler. The temperature must be regulated by a thermometer, which when used must be plunged deeply into the water.

The basket must be completely immersed each time, then lifted quite out of the water so as to allow it to drain for four or five seconds before it is dipped again.

The above process in practice will be found simple and easy enough to perform, although its description is necessarily somewhat complicated.

REVIEWS OF RECENT LITERATURE.

ARTHUR, J. C. *Smut of Wheat and Oats.* Bulletin of the Agricultural Experiment Station of Indiana, No. 28, September, 1889.

While containing little or nothing new, this little bulletin is full of practical matter and will be an invaluable aid to those whose crops are attacked by these diseases.

Most of the bulletin is taken up with *Tilletia fœtens*, or "stinking smut," as Professor Arthur calls it, to distinguish it from black smut.

The fungus is described, and some space is devoted to early opinions as to the origin of smut. In the discussion of the name the author says that the name *Tilletia lævis* should be changed to *T. fœtens*, Rav., since Ravenel was the first to describe and name it.

Under the heading "attack and spread of the disease" the following questions are proposed and answered: "Will the smut spread from field to field while the crop is growing, as rust does? Will there be any danger of introducing it on one's farm by sowing seed wheat from a farm known to be smutted? Can the disease be introduced by the ap-

plication of manure from a farm where it has already gained a foot-hold? When it once gets into the soil will it persist as milk-weed, quack-grass, and Canada thistle do?"

The answer to the first question depends upon when and where the germinating spore enters the wheat plant. It has been pretty well settled that the plant is infected at the time of germination, and the germ tube enters near where the plantlet is attached to the grain. The practical application of this fact is that grains covered with soil can only receive infection from spores that were sown with the seed or already existed in the soil, but that smut will not spread during the growing season from field to field or from plant to plant.

The answer to the second question is a logical sequence of the preceding. If a crop has any portion smutted it is more than probable that the spores of smut will get in contact with the sound wheat kernels. One crushed kernel thoroughly distributed through a bin of seed wheat may result in many dollars' loss when the crop is harvested. Other sources of contamination are also given, viz: The thrasher having previously been used for smutted wheat; being stored in a bin or passed through a fanning-mill or seeder not properly cleansed after being used for smutted wheat; by using sacks that have not been disinfected.

The third question is answered in the affirmative. It has been shown that corn smut can pass through animals and retain its germinating power, and the same is likely true of wheat smut.

Spores retain their power of germination when dry for two or three or even more years, but in the field we may safely assume that two years will eliminate every trace of it.

Natural checks to its increase are ably discussed; they are, mainly, probability that the spores may not be near enough to the germ end of the kernel, insufficient moisture, and resistant varieties.

The nature of the injury is of a more comprehensive nature than is generally supposed. A definite percentage of the crop is actually lost. An extra amount of cleaning and screening is required for what is good. The wheat is unfit for seed until disinfected. The smut gives the flour a dark color and disagreeable smell. The straw and screenings are liable to spread the disease when converted into manure.

Under the heading "remedies and precautions" the author says that the prevention of smut costs not a fraction of the trouble or expense that is necessary in removing the Colorado beetle from potato-vines. The method of disinfection preferred is a soaking of the seed in a solution of blue vitriol, and several methods for doing it are given in full. The methods of prevention are very emphatically summed up as follows: "Clean seed upon a clean field will result in a clean crop."

Very little space is given to the black smut; its general appearance, habits, and botanical characters are described. The same method of treatment as that described for stinking smut is recommended for this

except that, on account of the hulls, oats and barley should be soaked longer.—E. A. SOUTHWORTH.

BOLLEY, HENRY L. *The Heteræcismal Pucciniæ.* American Monthly Microscopical Journal, Vol. X, 1889.

The author of this paper starts with a general account of the biology and classification of the *Uredineæ*, gives a short description of the internal arrangement of the order, as well as its position among the fungi, and a definition of *heteræcism*, ascribing as a cause "inherent wants of the parasite not to be satisfied by one of its hosts alone," rather than to any difficulty which the promycelia might find to an entrance into the host tissue. Taking up the mycelium, a short description is given, with a belief that there are no true haustoria, but that young mycelial threads, penetrating the cell walls, give the misleading appearance. The article treats of æcidia and spermogonia at some length, without, however, attempting to clear up the mystery of their designed use. Under the account of the teleutospore, a doubt is expressed in regard to the existence of the so-called germ-pores. The author finds in the process of germination, instead of the passage of a germ-tube through a previously formed canal, a gradual erosion of the endospore from within. In regard to the question of sexual or non-sexual reproduction in the order, the work of Dr. George Massee is criticised, claim being made that the stroma, which bears ultimately the æcidial spores, does not consist, as figured by the latter, of a stalked body, but of a mass of interlaced hyphæ—branches and extensions of ordinary hyphæ. In the cases studied by Mr. Bolley *Æ. berberidis* and *Æ. hepaticarum*, the basidia arise as bud-like branches from individual hyphæ without any characteristics of a sexual process, and the author coincides with H. Marshall Ward in the thought that this process has disappeared, not being longer needed by the fungus.—D. G. FAIRCHILD.

FARLOW, W. G. *Notes on Fungi.* Botanical Gazette, August, 1889.

In the last number of the *Botanical Gazette* Dr. Farlow gives an account of a *Cystopus* causing peculiar swellings on the stems of *Ipomœa pandurata*, sent him by Prof. L. H. Pammel from Missouri. It appears from the note that the form of *Cystopus* upon the *Convolvulaceæ* of the United States has hitherto been found wanting in oospores, raising the question whether or not it should be united under *C. cubicus* (Strauss), Lév., which inhabits the *Compositæ*. The specimens sent by Professor Pammel seem to have abounded in peculiar oospores. The oogonia also differed from those of others of the same genus, in having their walls raised in blunt papillæ or short flexuous ridges over the whole surface. Differing as it does in oogonia and oospores from *C. cubicus*, the author thinks it clearly can not be placed under it. The name *C. convolvulacearum*, Otth, used by Kellerman and Ellis, is considered, after correspondence with Dr. Fischer, of Berne, as only a manuscript name used by

Otth and first published by Zalewski, in 1883; which latter authority for *C. convolvulacearum* is consequently preferred, but the author considers the Schweinitzian name *Æcidium ipomœæ-panduranæ*, given in 1822, as the first name applied to the form on *Convolvulaceæ* in North America.

Mention is made in the same paper of a very interesting *Peronospora*, found to agree with *P. Cubensis*, B. & C., which has been found independently in Cuba, Japan, and New Jersey, in which latter place it has attacked most vigorously the cucumber vines. It is especially interesting biologically as an exception to the general rule that only small conidial spores produce zoospores.—D. G. FAIRCHILD.

CAVARA, DR. F. *Materiaux de Mycologie Lombarde*, Revue Mycologique, October, 1889.

The author gives a list of the fungi of Lombardy, the following orders being represented: *Myxomycetes*, 4; *Zygomycetes*, 4; *Oomycetes*, 12; *Ustilagineæ*, 4; *Uredineæ*, 11; *Discomycetes*, 12; *Pyrenomycetes*, 33; *Hyphomycetes*, 44; *Sphæropsideæ*, 41; *Leptostromaceæ*, 4; *Melanconeæ*, 13; Imperfect forms, 3. Fifteen of the species are new and are fully described and illustrated by two plates. There are also many interesting notes on some of the injurious species.—B. T. GALLOWAY.

FULTON, T. WEMYSS. *The Dispersion of the Spores of Fungi by the Agency of Insects, with Special Reference to the Phalloidei.* Annals of Botany, May, 1889, p. 207.

This interesting article may be divided into two rather distinct parts, the first comprising the results of Mr. Fulton's experiments with *Phallus impudicus*, and the second containing data gathered from different sources to prove that the adaptation of fungi for the visitation of insects is quite general among certain families.

After a description of the structure and development of the common Stinkhorn (*Phallus impudicus*), attention is drawn to the fact, noticed previous to 1575, that the liquefied hymenium, or stinking slime, of this species has great attractions for insects, especially two species of fly, *Musca vomitoria* and *Musca Cæsar*. To settle two important questions suggested by these insects feeding upon the slime filled with the ripe spores of the fungus, the effect of the slime upon the fly and the effect of the fly upon the spores, the author conducted two series of experiments. The first series, involving the first question, proved, as might be expected, that the slime has no effect upon the fly either before or after death. The second series, consisting in an attempt to produce the fungus from spores which had traversed the digestive organs of the fly, was measurably successful, although slightly incomplete, from the fact that only two out of four trials produced the characteristic mycelium, and of these, the one given an opportunity to develop its compound sporophore failed to do it. The author does not mention in his account of the experiment any attempt to free the excrement from

spores which might have been shaken from the feet and proboscides of the flies and have not traversed the digestive canal. From the connection it might naturally be supposed that no attempts were made.

Turning from a determination of the fact experimentally, the author, first making the statement that "it seems very probable that most all of those fungi whose spores are ultimately contained in a slimy or liquid substance of dark color, especially if of a fetid odor, and which is freely accessible, will be found to have their spores largely transported by the agency of insects," takes up the British *Coprini*, pointing out the superficial resemblance of their sporophores to the compound flowers of certain *Compositæ* and calling attention to the fact, in connection, that flies are alike the principal visitors of the flower and the fungus.

The *Phalloidei*, which to the author present the most striking adaptations to insect visitations, occupy considerable space in the paper, short tabulated descriptions—color, odor, habitat, and dimensions—of 59 species being contained. The summary from these descriptive tables shows that the color of the receptacle during the deliquescence of the hymenium in more than half of the species is some tint of red, and in the remainder, white; these colors occurring in 91 per cent. of the 59 species. Table IV gives the colors of more than a thousand species of fungi, other than *Phalloidei*, and reveals the fact that while 91.5 per cent. of the latter are either red or white, only 20.1 per cent. of other fungi are so colored, the great majority being brown, slate, or black—colors scarcely represented in the former group. The bearing of these data upon the author's inference that the brilliant tints of the *Phalloidei* have been developed to render them conspicuous is quite pointed, and when taken in connection with his last table—which is a comparison of 4,197 species of flowers with 59 *Phalloidei* and 1,288 other fungi—becomes doubly so. Table V shows that while only 73 per cent. of flowers and 24.7 per cent. of other fungi are white, red, or yellow—colors found by experiment to be the most conspicuous in wooded localities where fleshy fungi grow—96.6 per cent. of the *Phalloidei* are so colored.

In regard to the odor, determined in the case of 25 species, 76 per cent. were fetid. When this proportion is compared with that of odorous to inodorous flowers—9.9 per cent. determined from 4,189 species—and taken in connection with the numerous facts just mentioned, the author is warranted in concluding that "in the *Phalloidei* it can scarcely be doubted that we have a group of fungi which have undergone great modifications so as to become adapted for the dispersion of their spores by the agency of insects."—D. G. FAIRCHILD.

GIRARD, ALFRED. *Entomogenous Fungi.* Bulletin Scientifique de la France et de la Belgique. January–April, 1889.

This number contains three valuable and practical articles on Entomogenous fungi. The first, entitled (*Sorosporella agrotidis*, nov. gen.

et sp.) "A New Parasite of the Caterpillar of the Sugar Beet," is translated by A. Girard from a German article by N. Sorokin.*

The "gray worm" (Caterpillar of *Agrotis segetum*) is, he says, very troublesome in the southern provinces of Russia, and, judging from previous experiences with the wheat aphis, he thinks it possible to fight the enemy effectually by means of entomogenous fungi; but it is of the greatest importance that each farmer should know beforehand the amount of fungous powder (powder containing the spores of the fungus employed) required to infect a given area. To this end Professor Cienkowski has calculated the number of spores contained in a square millimeter and then in a cubic foot. Professor de la Rue has also estimated how much pure spore powder it requires to cover a given area with a layer of spores .008 of a millimeter thick (twice the thickness of a spore). This calculation is supplemented by Professor Saikewitsch, who has determined that the interstices of a given amount of earth will take up one half its volume in pure spores, so that if impure powder is used twice as much will be required as of the pure.

The author placed several diseased "gray worms" in a box, where they soon died, and on examining them he decided that they were infested by a hitherto undescribed fungus to which he gave the name *Sorosporella agrotidis*. It is with this fungus that he hopes to be able to conquer the *Agrotis*.

The second article is a review of the preceding by the editor and translator, Alfred Girard.

He has compared Sorokin's description with Krassilstschik's description of *Tarichium uvella*, also a parasite of *Agrotis segetum* found in Southern Russia, and considers that the two fungi are probably identical. The name, he says, should be *Sorosporella uvella*, as the *T. uvella* of *Krassilstschik* can not be considered an *Entomophthora*, but is more closely related to the genus *Massospora*, Pk.

Northern France is, he says, as subject to attacks from the "gray worm" as Southern Russia, and the most chimerical remedies have been used to fight the scourge. In France he has often met a parasite of the "gray worm," *Entomophthora megasperma*, Cohn., which was of great aid in stopping the ravages of the *Agrotis* in 1867.

Unfortunately, however, only the *Tarichium* form—that is the resting spores—is to be found either in France or Germany, and all attempts at infection with it have failed. These resting spores may, however, develop and produce conidia in certain culture media. The best one for *Entomophthora calliphoræ* being the excrements of a batrachian.

From an incomplete experiment of Krassilstschik it would seem that under certain conditions *E. megasperma* develops the conidial form on the caterpillars of *Agrotis*, and the author suggests that this result might be regularly obtained by keeping the "gray worms" under glass, just

* Published in the *Centralblatt für Bakteriologie und Parasitenkunde*, 1888, IV. Bd. n. 21, pp. 644–647.

as the parthenogenetic generations of aphides can be indefinitely multiplied by keeping them in a continual summer environment. These suggestions are given to indicate the proper line of experiments to be followed out in fixing upon some plan for exterminating the "gray worm" in countries where it is injurious; and the paper closes with the remark that it is time to start in France an entomological department like the one now in operation in the United States.

The third article is another review by A. Girard, this time of a Russian paper, by Krassilstschik, bearing the Latin title: "*De insectorum morbis qui fungis parasitis efficiuntur.*" Much of the article consists of a critical analysis of Krassilstschik's work, and those parts will be omitted. In this review I shall only touch upon the points which have a bearing on the subject in question, and what follows will mainly consist of very free translations of portions of Girard's paper.

On the practical side of the question Krassilstschik seems to have obtained very remarkable results. Artificial cultures of the conidial form (*Isaria*) of certain *Pyrenomycetes* appear to have been made as easily as those of yeast or *Schizomycetes*. This success is very encouraging, and should impel us to take up new experiments on the *Entomophthoreæ*, which, up to the present, have resisted every attempt to cultivate them in lifeless media. Thaxter's researches have shown that some *Entomophthoreæ* are less exclusive in their choice of a host than was formerly supposed.

If Thaxter's experiments are verified, can not we cultivate *E. grylli* on the caterpillars of *Arctia*, which are so common and easy to raise, and use the spores so produced to infect the *Acrideæ* and arrest their ravages?

The observation of an *Entomophthoreæ* parasite on *Cecidomya destructor*, Say, is of very great interest. *Cecidomya destructor* is one of the most injurious insects, and it would be very important to be able to effectually combat it Krassilstschik has met this fungus both in the *Tarichium* and conidial state. He has also discovered an *Entomophthora* on the caterpillar of the nocturnal *Agrotis segetum*, which, in the vicinity of Odessa, especially attacks the rye. This is a very interesting fact, he observes, for Cohn has found a *Tarichium* on the same caterpillar without ever having met any conidia. In northern France I have met only the *Tarichium* form of the *Entomophthora* of the *Agrotis*, but a few mummified caterpillars which I placed in a moist chamber at a somewhat elevated temperature became covered with a whitish down analogous to the conidial stage of the *Entomophthoreæ;* unfortunately the observation was interrupted and I was unable to demonstrate the presence of conidia.

The discovery of *Botrytis Bassiana*, Bals. on two new hosts (*Musca domestica* and *Athalia berberidis ?*) made by Kowalevsky in the neighborhood of Odessa deserves special note. We know that Metschnikoff has already observed the white muscardine on *Anisoplia*. Krassilstschik

has found the same parasite upon *Cleonus punctiventris*, Germ. The insects that are so formidable to beet growers of southern Russia may then be effectually combatted by three fungi; the green muscardine (*Isaria destructor*, Metsch.), the red muscardine (*Sorosporella uvella*, Krassil.), and the white muscardine (*Botrytis Bassiana*, Bals.).

Vendhalm and Krassilstschik have also discovered a new species of *Isaria* upon an undetermined *Lixus* (larva and nymph), an *Isaria* that can undoubtedly be utilized in ridding ourselves of the different Curculios that attack the *Carduaceæ*.

But the fungus which Krassilstschik has most thoroughly studied is one which he has met on the eggs of the migratory locust (*Pachytylus migratorius*). This is a conidial form which Krassilstschik believes belongs to the *Isaria* of *Cordyceps ophioglossoïdes*, Ehr. & Tul.; this is also, it seems, the opinion of Professors Cienkowsky and Reinhardt, who have seen his preparations of the fungus.

If the *Isaria* on locust eggs is really *Isaria ophioglossoïdes* we find ourselves in the presence of a very curious fact.

The locust eggs evidently do not supply the fungus with sufficient nutriment for the development of the highest order of reproductive organs—the asci. But how does it happen that in certain localities *Cordyceps ophioglossoïdes* abandons the eggs of the *Acrideæ* to develop further on *Elaphomyces?*

The *Elaphomyces* are subject to invasions of numerous parasites and in particular of the dipterous larvæ of the genus *Helomyza*. Now the *Diptera* of this group are in turn often infested by entomogenous *Sphæriaceæ*. It seems to me very probable that the *Cordyceps* parasitic on *Elaphomyces* lived at first in the *Isaria* stage upon the larvæ of the *Diptera* which infested them, and from there extended their mycelium to *Elaphomyces* itself, where, thanks to more abundant nutriment, they could produce their asci. It is even possible that this might have occurred during the phylogenetic evolution, and that at present *Torrubia ophioglossoïdes* and *capitata* attack *Elaphomyces* directly.

The article concludes with the following direct translation (into French) from Krassilstschik's paper.

Although De Bary is lately inclined to accept Tulasne's view that *Isaria* is only the conidial form of *Cordyceps*, and considers it very probable that *Isaria farinosa* belongs to the cycle of development of *Cordyceps militaris*, it is necessary to observe that the genus *Isaria* comprehends an enormous number of forms; and since the union of this genus with that of *Cordyceps* is probable only for one species, it is useful for the time to retain the genus *Isaria* and to designate each form by a special name.

As to *Botrytis Bassiana*, De Bary as well as Brefeld formerly considered it as the conidial form of a Pyrenomycete (*Melanospora parasitica*); he appears, however, to have given up the idea after numerous cultures and experiments.

The genus *Stilbum* has but a few victims and one representative among muscardine fungi. This one is *Stilbum Buqueti*. Although this fungus is not perfectly well known, and for that reason we can scarcely expect to know whether it passes all its stages on insects, still, according to Buquet, the fungus develops only on dead insects; and, judging from Robin's descriptions and excellent drawings, we must accept his view that *Stilbum* develops while the insect is living, completing its development after the death of the same; in a word, it behaves like a true muscardine.

In regard to *Tarichium* I have already said that this genus ought to follow *Entomophthora*. The difficulty of making artificial cultures of *Tarichium* and the impossibility of the artificial infection of insects with the spores of this fungus render the study of this group of organisms extremely interesting.

In the fungi noted on our list as accidentally developing on insects and possessing an entomogenous function, is one representative of the genus *Cladosporium*. Although the majority of the species of this genus are known as parasitic on plants, and *Cladosporium* does not exhibit parasitic qualities in the animal kingdom, it is necessary to call attention to the one case of this kind supported by a mycologist as experienced and learned as Professor Salensky, of Kazan. It may seem a little strange at first thought that a parasite as useful as *Cladosporium parasitium*, Sorok., which lives upon *Polyphylla fullo*, can be in a given case understood as only an accidentally saprophytic fungus.

It is useless to speak of *Penicillium* as entomogenous. *Penicillium glaucum*, which, in the opinion of Lohde, may be parasitic on a butterfly, *Bryophila raptricula*, can in no sense be reckoned among the entomogenous fungi; and if *Penicillium glaucum* does develop on dead chrysalides that are really attacked with muscardine it is simply as an after effect and a saprophyte. There is no doubt that the chrysalides of which Lohde speaks were already affected by another parasitic fungus before *Penicillium glaucum* developed.

The yeast fungi have nothing in common with the muscardines, and if formerly it was possible to believe, as Bail did, that the house-fly was killed by a yeast fungus, we know now, after the excellent researches of Brefeld, that the supposed yeast is only an *Entomophthora* in a certain stage of development. * * *

It is still necessary to mention the genus *Metarhizium* of which there are also certain representatives on our list. This new genus was established by Prof. N. Sorokin for the green muscardine, discovered by Metschnikoff upon the larvæ of *Anisoplia austriaca*, and called by him *Entomophthora anisopliæ*. As the characteristics of this fungus do not perfectly agree with those of *Entomophthora*, Professor Sorokin proposed to call it *Metarhizium*. But as Metschnikoff has since given the green muscardine the name of *Isaria destructor*, and as my long observations upon this fungus and a large number of pure cultures have proved to

me that the fungus of the green muscardine approaches in every respect the genus *Isaria*, the name *Metarhizium* became useless, the more so because the other representatives of this genus were imperfectly established. The fungus of the green muscardine has, besides, the typical aspect of an arborescent *Isaria* upon the larvæ of *Cleonus punctiventris* when placed in moist sand. In artificial cultures *Isaria destructor* is known besides under the form *Coremium*.

The ingenious names which Lebert has given to different forms of entomogenous fungi, such as *Verticillium*, *Polistophthora*, *Acanthomyces*, etc., by no means represent new forms but are only synonyms for *Cordyceps* and *Isaria*.

It remains to be seen in how many cases muscardine parasites of insects can develop under artificial conditions. It is said that experiments were made upon twenty-four different species of insects and always gave favorable results. Besides these, there were four other cases of contagion, which, although observed under artificial conditions (not in open air), did not arise from spores sown intentionally.

In these latter cases the parasite developed upon insects inclosed in bottles or boxes. It is interesting to note that in almost every case artificial infections are due to fungi of the genera *Isaria* and *Botrytis;* that is to say, to fungi whose artificial cultures succeed marvelously.

On the contrary, infections with the genera *Cordyceps* and *Entomophthora* are more restricted in number. Up to the present time artificial cultures of these genera have not succeeded at all. For the genus *Cordyceps* we have but one experiment by De Bary and for *Entomophthora* three experiments by Brefeld. No experiments have been attempted with *Stilbum*, but judging from the structure of the fungus, so like that of *Isaria*, it appears probable that artificial cultures and infections will succeed as well with it as with *Isaria*. With *Tarichium* all attempts of contagion have failed completely, and consequently artificial culture is shown to be impossible.

If later researches confirm the cycle of development of *Tarichium urella*, and if the complete development of other representatives of this genus can be obtained in artificial cultures, it will then be possible to attempt infection with spores artificially produced. As has been indicated, the ordinary spores of *Tarichium* will never produce contagion when placed in contact with the bodies of insects.—EFFIE A. SOUTHWORTH.

HARTIG, Dr. ROBERT. *Lehrbuch der Baumkrankheiten.* Zweite verbesserte und vermehrte Auflage. Mit 137 Text-Abbildungen und einer Tafel in Farbendruck. Berlin. Verlag von Julius Springer, 1889. 8vo, cloth, pp. 291.

The second edition of Dr. Hartig's *Lehrbuch* embodies much interesting information in a convenient form and can not fail to meet with the same favorable reception as the first edition published in 1882.

Only one lithographic table has been introduced and an effort has been made to simplify the text as much as possible. What is here omitted the specialist will find in original papers, which in any event he would desire to consult, and the general reader will welcome the clear style and freedom from technical description. The individuality of the author is visible everywhere. He has copied no one, not even in the matter of wood-cuts and the result is an exceedingly interesting and useful book.

The introduction discusses briefly:

(1) The development of the doctrine of plant diseases (commencing with Schreger, 1795); (2) Causes of disease; (3) Methods of investigation.

The body of the work is divided into four sections: (1) Injuries by plants; (2) wounds, *i. e.*, mechanical injuries; (3) sickenings through influence of the soil; (4) sickenings through atmospheric influences. The first section contains 175 pages, the greater part of which is devoted to parasitic fungi. The treatment of this subject is somewhat broader than the title of the book would indicate, brief mention being made of diseases attacking grains, vegetables, and other herbaceous plants.

The author is most at home upon the wood-infesting and tree-destroying species, to which he has devoted many years of profound and painstaking inquiry. The following *Hymenomycetes* are described as destructive to living wood: *Trametes radiciperda*, *T. pini*; *Polyporus fulvus*, *P. borealis*, *P. vaporarius*, *P. mollis*, *P. sulphureus*, *P. igniarius*, *P. dryadeus*; *Hydnum diversidens*; *Telephora Perdix*; *Stereum hirsutum*, and *Agaricus melleus*. Mention is also made of *Polyporus fomentarius*, *P. betulinus*, *P. lævigatus*, and *P. Schweinitzii*, and the author believes that numerous other *Polypori* not yet critically investigated live as parasites in the wood of trees. *Dædalea quercina* and *Fistulina hepatica* are also probably parasitic, at least the former.

The destruction of timber receives considerable attention. There is a "dry rot" due to various fungi, the spores of which often find their way into cracks on the surface of logs while lying in the forest. These spores germinate the following summer while the logs are at the mill, if the heat and moisture are sufficient. The first symptom is a red-striping of the timber. The loss from this cause in the Bavarian forest is stated to be 33 per cent. of the entire product. The most vexatious timber-destroyer appears, however, to be the house fungus *Merulius lacrymans*. This attacks and destroys low lying or damp portions of buildings, and is peculiarly a plant associated with men, although it sometimes occurs in the forest. The extremely minute spores, about four million of which could be packed in the space of a cubic millimeter, germinate only in presence of some alkali, and this is thought to be the explanation of the fact that the fungus is most likely to appear in parts of buildings wet by urine, ashes, etc. When fresh, this fungus

has a very agreeable smell and a fine taste, afterward somewhat astringent. The mycelium excretes large quantities of water and keeps dwelling rooms excessively damp. In decay, the sporophores produce a very characteristic disagreeable odor, which is undoubtedly prejudicial to health. Infection may take place either through mycelium or spores. The latter are often carried from place to place on clothing, tools, etc., which have been used by workmen, especially carpenters, in repairing decayed buildings.

The book seems to have been very carefully prepared, but some omissions are noteworthy, and occasionally one meets a questionable statement.

Under *Gymnosporangium* four species are mentioned—*G. conicum* (*juniperinum*), *clavariæforme*, *Sabinæ* (*fuscum*), and *tremelloides*. The author thinks a further investigation of the forms thus far known and described is desirable, as the results of some experiments instituted by him do not agree with those commonly accepted. No mention is made of the labors of Dr. Farlow or of Dr. Thaxter.

Under bacteria Dr. Hartig urges the commonly accepted view that the acid reaction of most plants is unfavorable to their growth and development, and evidently thinks they play a very unimportant rôle in the production of plant diseases. They have been found as parasites, he says, only in thin-walled, soft parenchymatous tissue, such as bulbs and tubers, and here are often preceded by fungi. Even in Waacker's hyacinth disease (the yellow, slimy bacteriosis) "the bacteria do not attack entirely sound, well-ripened bulbs under normal conditions," but only those that have been wounded or previously attacked by fungi, especially by a hyphomycetous fungus, which is almost always associated with this bacteriosis. In damp places the bacteria enter the wounds and cause the rot. The following paragraph on pear blight will hardly pass muster, and was certainly not to be expected in a handbook published in 1889. All the recent American publications on this subject, especially the papers by Dr. Arthur, appear to have escaped the author's attention.

> Recently a disease of pear and apple trees, called blight, has been described by J. Burrill in Urbana, Ill., the cause of which this investigator ascribes to the invasion of a bacterium. The disease appears to bear a resemblance to the tree canker (*Baumkrebs*) caused by *Nectria ditissima*, and since in this fungus small bacteria-like gonidia are produced in great numbers in the bark, it becomes necessary to inquire first of all whether this disease has not been wrongly ascribed to a schizomycete.

Mention is made of fifteen species of *Exoascus*, all of which produce characteristic hypertrophies. Seven of these species also cause *hexenbesen* or witchbrooms, and these peculiar growths are also induced by various *Uredineæ*, notably by the æcidium (*Peridermium pini*) of *Coleosporium senecionis*, and by *Æcidium* (*Peridermium*) *elatinum*.

The black-knot of the plum and cherry, *Plowrightia morbosa*, is said to occur only in North America, but the author thinks it may be in-

troduced into Europe at any time. This is quite likely and the wonder is that it should not have occurred before, owing to the fact that it is found on all our species of *Prunus* and is very destructive in many parts of the eastern United States.

The volume ends with a brief index, preceded by a convenient synopsis of diseases (215 in number). This is arranged alphabetically according to hosts, and under each host according to organs, so that the reader who knows the name of the host and of the part attacked can quickly refer to the description of the disease in the body of the text.—ERWIN F. SMITH.

KELLERMAN & SWINGLE. *Branch Knot of the Hackberry.* Report of Botanical Department, in First Annual Report of the Kansas Experiment Station, 1888.

This article is especially interesting to lovers of fungi from the fact that it relates to the peculiar double effect of plant parasite and insect irritation upon the same portion of host tissue. The infecting fungus *Sphærotheca phytoptophila*, Kell. & Sw., appears to be a new and quite distinct species, choosing as its home the peculiar formations caused by a *Phytoptus* or gall-mite, which remains as yet undescribed. Many small branches of the hackberry (*Celtis occidentalis*, L.) have upon them knots and clusters of small abnormal twigs, which were supposed to be wholly due to the attacks of insects until the authors of this paper in March, 1888, discovered the mycelium and fruiting bodies of this new powdery mildew growing upon the buds and stems of the diseased portions. Up to this time only two species of the *Erysipheæ* had been found growing upon the *Celtis*, both of which belong to the genus *Uncinula*, and only one as an inhabitant of Phytoptus galls—a *Microsphæra*. A portion of the article is taken up with a description of the curious distortions caused by the gall-mite and mildew combined, two photo-lithographs of different styles or types being added. Following this is a short account of the general characters of the *Erysipheæ* and a very full and carefully prepared description of the species in question. The presence of *Cicinnobolus Cesatii*, DBy., the common parasite of the powdery mildews, is noted, and shares with the gall-mite a short description. As remedies for this complex disease, which disfigures and enfeebles the hackberry trees—used quite frequently for ornamentation in the West—the authors suggest the use of sulphur and its compounds along with that most effective of preventive measures, a removal and destruction of the diseased portions during the winter season.

Whether or not the fungus and gall-mite are independent of each other the paper does not attempt to decide, but leaves the matter for further experimentation, throwing out the suggestion that it may be possible for the mite to form galls without the fungus, but not for the fungus to live separated from the gall.—D. G. FAIRCHILD.

SCRIBNER, F. L. *Diseases of the Irish Potato.* Bulletin of the Agricultural Experiment Station of the University of Tennessee, April, 1889.

In this paper the author discusses the potato rot, caused by the fungus *Phytophthora infestans*, and a new disease, due to a nematode or thread-worm. After giving a detailed account of the habits of the former, the paper concludes with a chapter on treatment, which is briefly summed up as follows:

Select for planting a light, sandy loam, or a soil which is well drained; plant only perfectly sound or disinfected seed; spray the tops with the Bordeaux mixture* or some preparation containing sulphate of copper; store in a cool *dry* place, and keep dry.

The new disease was discovered among the potatoes obtained from the University farm, and is described as causing the tuber to wither, then dry up, and become hard. The skin is only partially discolored, but the surface is covered with small pimples, each surrounded by a depression. Sections through a diseased tuber revealed the fact that the flesh was apparently sound, but slightly wilted. The only discoloration of the flesh was immediately under the pimples; here the tissues were brown. Under the microscope it was seen that the brown areas were filled with numerous little worms of various sizes and in all stages of development.

"These little worms," says the author, "were at once recognized as nematodes or thread-worms, and were evidently the cause of the disease."

"How did these worms get into the potatoes? Probably from the soil in which they were grown, for it is known that many of the parasitic nematodes spend a certain period of their existence under ground. It is very likely that they were first introduced into the University farm through planting infected seed. The potatoes planted were being saved for seed, and were these to be planted they would certainly carry the worms to the new crop and thus perpetuate the disease."

Owing to the limited knowledge of the life history of the nematode, the author says it is impossible to indicate any definite course of treatment.—B. T. GALLOWAY.

SHIPLEY, A. E., Cambridge, England. On *Macrosporium parasiticum.* Annals of Botany, May, 1888.

This is a note probably called forth by Kingo Miyabe's paper which was reviewed in the last number of THE JOURNAL.

In 1887 the author was sent to the Bermuda Islands to study an onion disease prevalent among the onion plantations of the colony and supposed to be due to insect attacks. He found a fungous disease having two stages, the first caused by *Peronospora Schleideniana*, the second by *Macrosporium parasiticum.*

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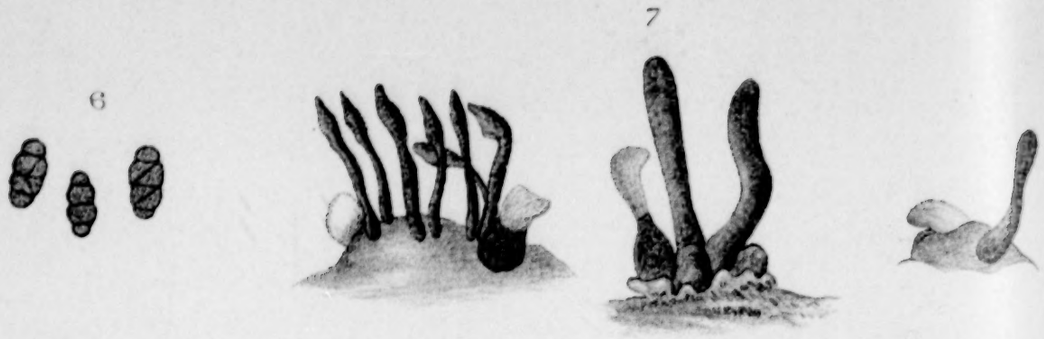
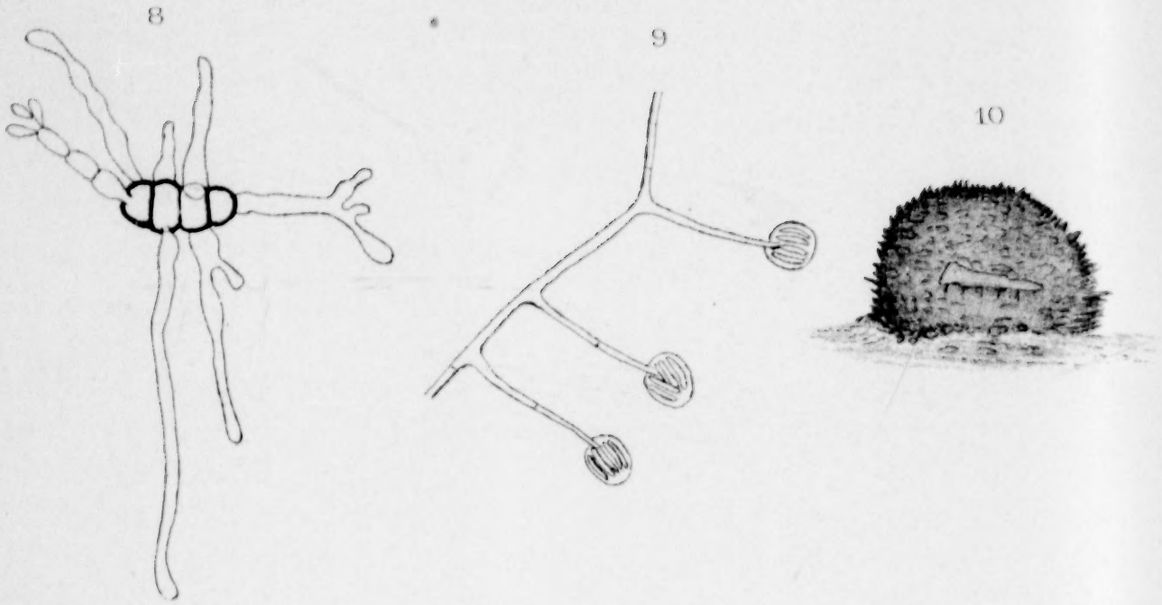
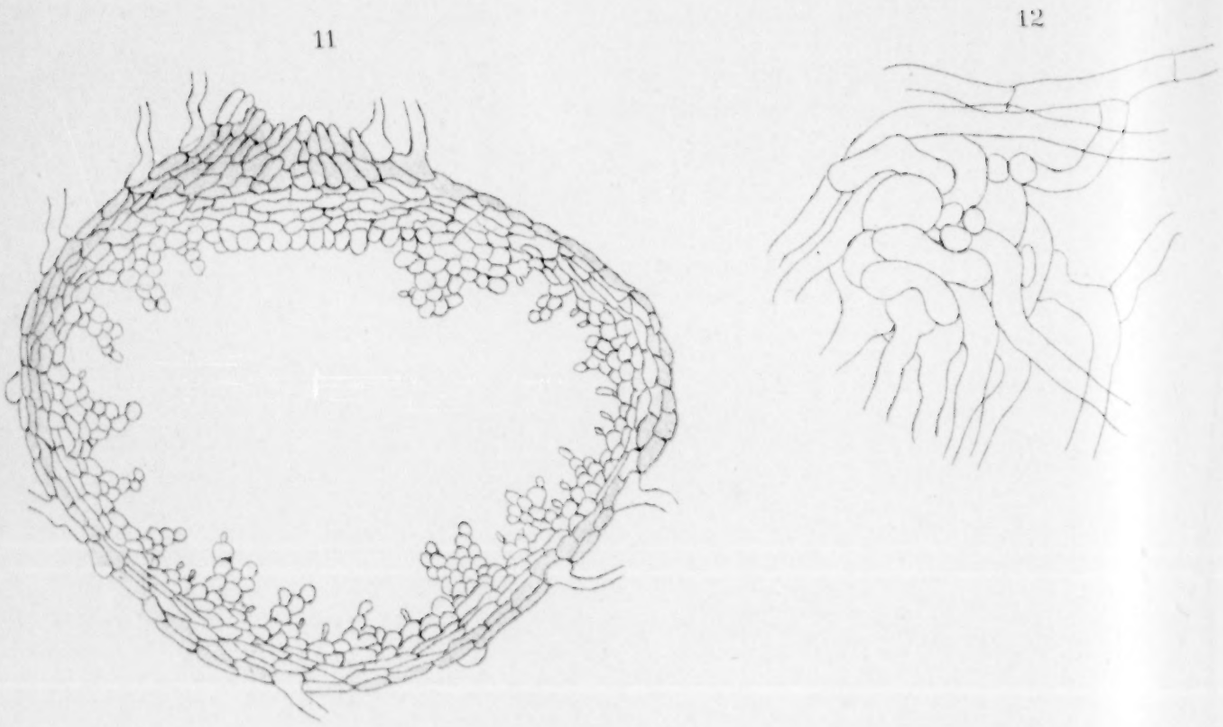
* See Mr. Weed's paper on page 158.



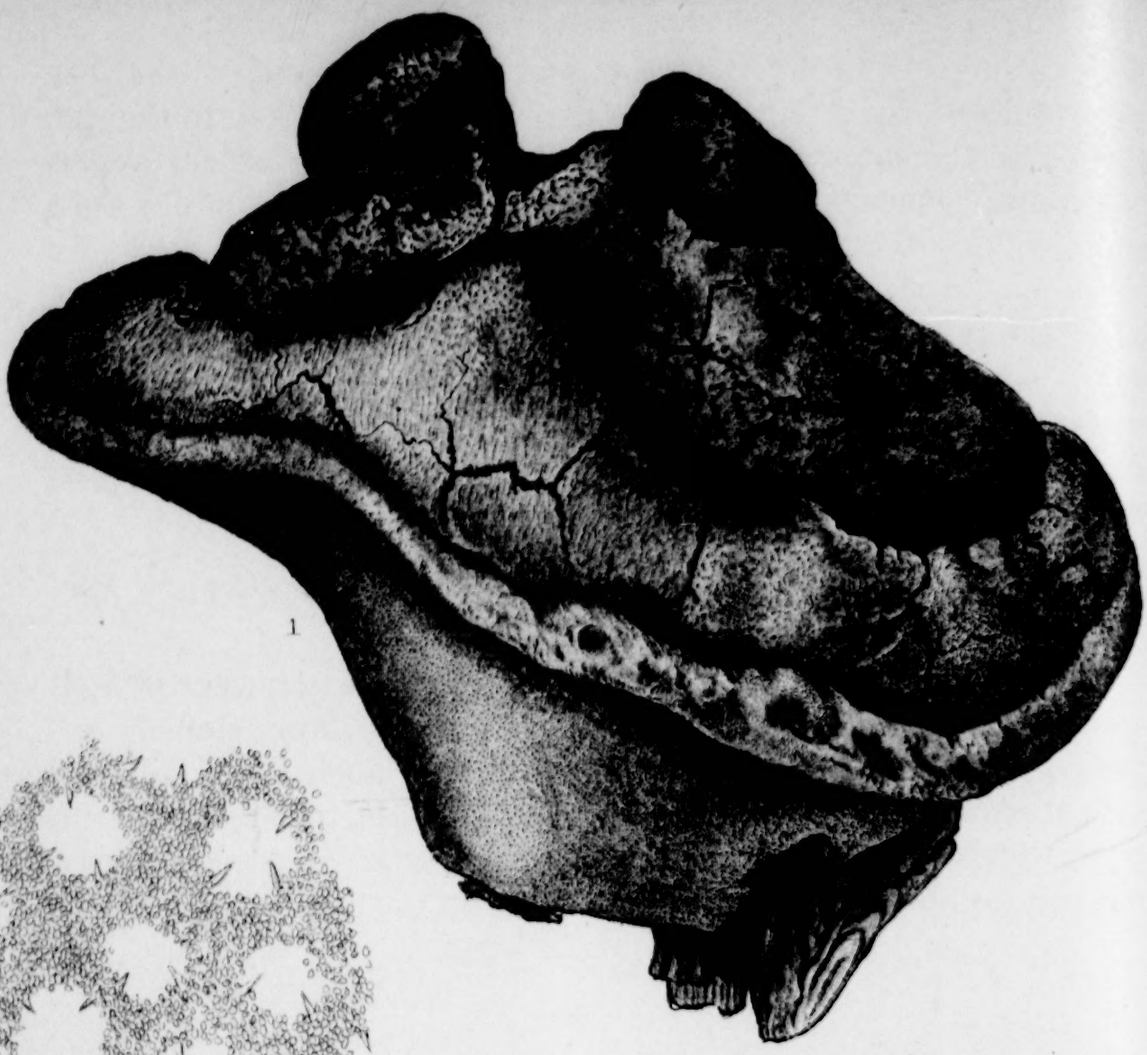




VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.

FENESTELLA PLATANI.

A. Hoen & Co. Lith. Baltimore.



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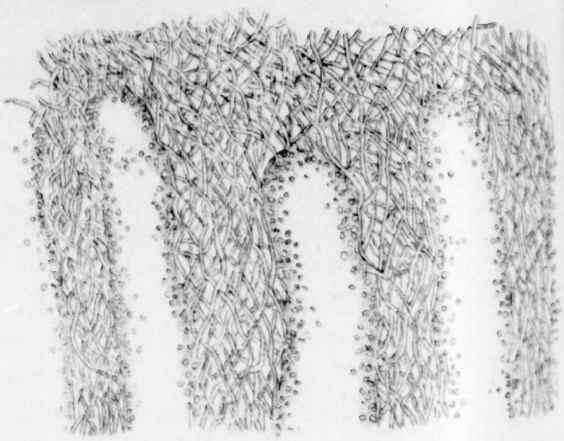

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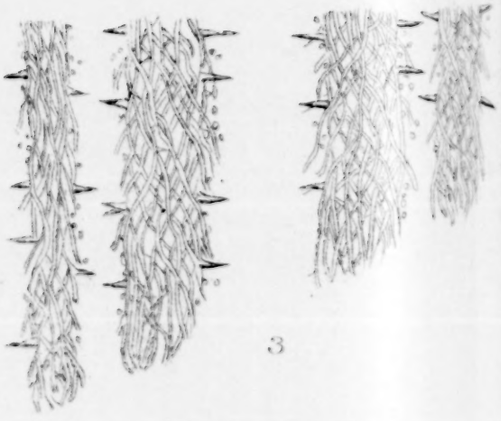

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ELLIS AND GALLOWAY ON A NEW MUCRONOPORUS.

MUCRONOPORUS EVERHARTII.

A. Hoen & Co. Lith. Baltimore

The mycelium of the *Macrosporium* ramifies through and not between the cells of the host, and the fertile hyphæ bore their way to the surface through the outer cell wall of the epidermis, their apices apparently exerting some solvent action on cellulose. He has not observed them projecting from the stomata as Mr. Miyabe did.

Mr. Shipley further takes issue with Mr. Miyabe in regard to the parasitism of the fungus. He has never seen a plant suffering from *Macrosporium* that had not previously been attacked by *Peronospora*. In other respects, except the development of the perithecia, which he did not observe, his observations confirm those of Mr. Miyabe.—EFFIE A. SOUTHWORTH.

UNDERWOOD & COOK. *Generic Synopses of the Basidiomycetes and Myxomycetes.*

This is the title of a work designed "as an aid to instructors as well as a guide to students wishing to pursue the study of fungi alone." Accompanying this work are one hundred neatly labeled specimens of fungi illustrating the more important groups. These, together with the synopses, which consist of twenty-one pages bound in a neat octavo volume, sell for $6.00.—B. T. GALLOWAY.

DESCRIPTION OF PLATES.

PLATE XI (*After von Tavel*).

FIG. 6. Ascospores. × 300.
7. External appearance of the stroma with perithecia and pycnidia. Slightly magnified.
8. Germinating ascospore, three days after being sown in water. × 600.
9. Hypha, with gonidiophores of *Acrostalagmus* in moist air. × 300.
10. Young pycnidium. The outer layer has become differentiated and the formation of the cavity has begun. × 80.
11. Vertical section through a pycnidium produced on a leaf. × 214.
12. Early stage of a pycnidium, from a cross-section through an infected leaf. × 700.

PLATE XII.

FIG. 1. *Mucronoporus Everhartii*, natural size.
2. A piece of the same showing length of pores in vertical section.
3. Longitudinal section of pores, with central portion cut out.
4. Spines enlarged.
5. Cross-section of pores.

ERRATA.

Vol. IV, p. 55, change "*Peziza solemæformis*, E. & E." to *Peziza Cazenoviæ*, E. & E., as there is already a *P. solemiiformis*, B. & C.; p. 118, line 4 from bottom, for "1168" read 1158.

Vol. V, p. 69, line 4 from bottom, for "Musie" read Music, and for "Christo" read Cristo; p. 78, line 4 from bottom, for "CYTOSPORINA" read CYTISPORINA; p. 78, line 2 from bottom, for "CYTISPORIUM" read CRYPTOSPORIUM; p. 79, line 11 from top, for "RANII" read RAUII; p. 79, line 13 from top, for "in Lett" read in Litt; p. 79, line 17 from top, for "AMORPHÆ" read AMORPHA; p. 80, in the statement "I have in the herbarium collected the previous year by F. W. Anderson, the following," insert *two* before "following;" p. 84, line 8 from bottom, for "already" read almost.

Dr. Fairman wishes the original Latin descriptions of the two following fungi, described on page 78, published:

DIDYMIUM FAIRMANI, Sacc. *Sp. nov.* Dignostitus peridiis sparsis, sessilibus, floccis hyalinis laxe reticulatis, spores levibus (8–10μ. d.); Crystallis eximie stellatis en; Columella sub globosa fuscella.

CONIOSPORIUM FAIRMANI, Sacc. *Sp. nov.* Ab affin. *C. Apiosporiade* differt conidiis multis minoribus (5–7μ. d.) globosis, levibus, fuligineis, 1 nucleatis.